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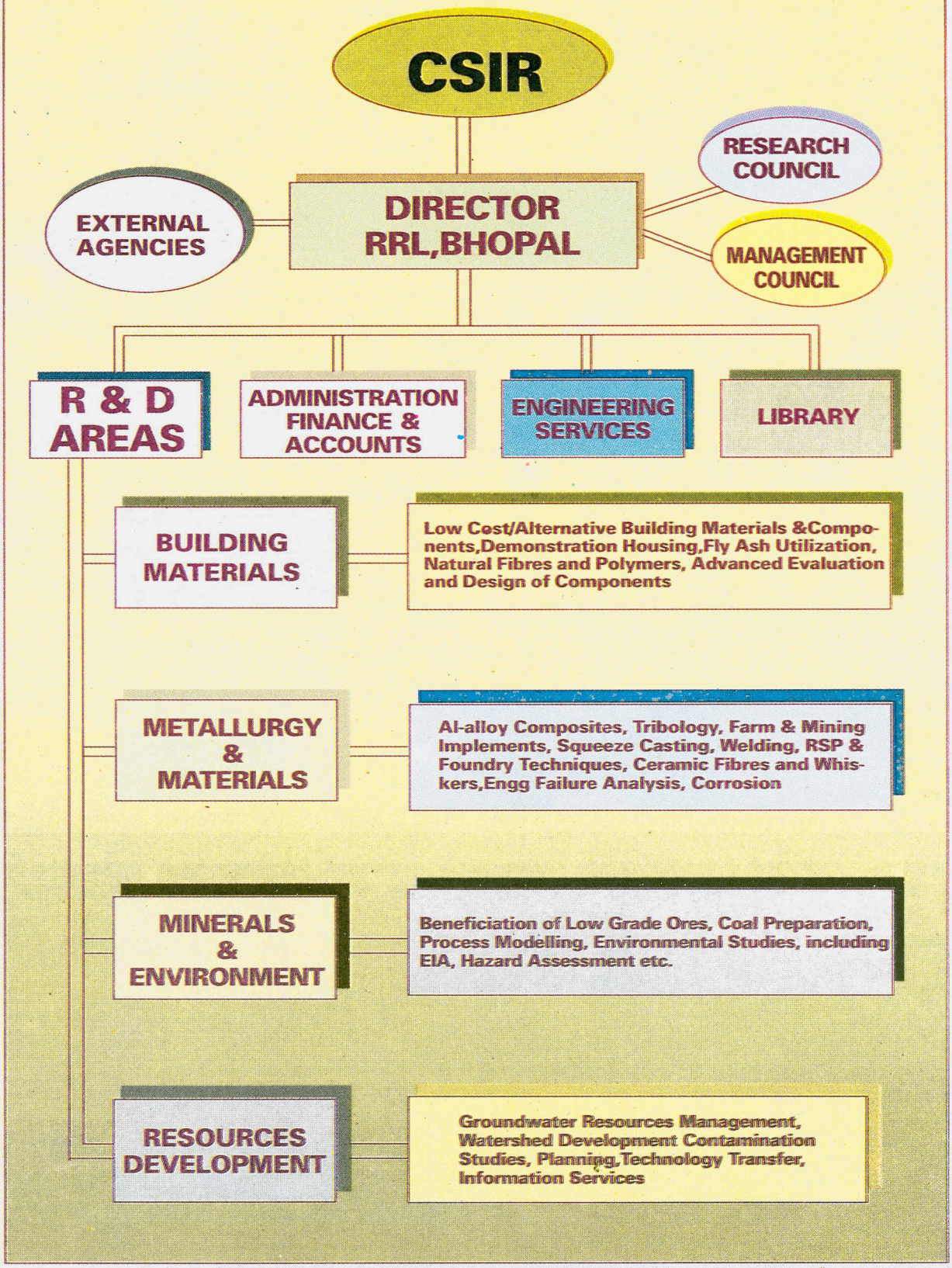
ANNUAL REPORT

वार्षिक प्रतिवेदन

1996-97

Regional Research Laboratory
Bhopal

ORGANISATION CHART



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Director's Report

Director's Report

It is a great privilege to present the Annual Report 1996-97. During this period RRL, Bhopal achieved generation of external cash flow of over Rs. 24 million. This has enabled a sustained performance of external cash flow at the levels of recurring expenditure. A steady phase of building up credibility through short term projects funded by user agencies, departments and industry has paved way to larger projects.

In the broad framework of major disciplines namely Building Materials, Metallurgy and Materials Science, Minerals, Resources Development and Environmental Studies, RRL has attracted significant contract research projects, consultancy and other assignments. The range of activities encompasses technology development, applied research, specialised technical services and S&T applications in regional development.

RRL has undertaken major assignments sponsored by the State Directorate of Sericulture on irrigation management in sericulture farms. The work involves water management in selected sericulture farms and development of irrigation potential in Rajgarh, Bilaspur and Sarguja districts of MP. RRL is also implementing a watershed development project in Raisen Dist. under the Rajiv Gandhi Mission of Watershed Development launched by the State Govt.

In the area of building materials, RRL continued work on wood substitutes, flyash bricks, mineral wool panels and integrated components design using various software packages. Construction of sixteen apartments using innovative techniques like, precast roof and new materials like wood substitutes, clay flyash bricks and red mud cementitious binder was completed. This was done under the assistance of National Building Organisation.

R&D programmes of RRL in Metallurgy & Materials emerged through integration of

existing capabilities and technical linkages in the areas like Metal Matrix Composites, FRP Components, Surface Engineering, performance improvement of mine and agricultural implements. Specialised technical services for failure investigations of components, structures for thermal power stations attracted considerable attention.

The laboratory started twenty three new projects in the area of improved materials for mining implements/machining, farm implements, surface engineering, innovative coal preparation and beneficiation techniques, flyash utilisation in land development for agriculture, environmental studies and water resources management. Twenty projects were completed during the year.

CSIR aspirations to provide S&T input to regional development manifested through a CSIR Workshop-Cum-Exhibition on Rural Technologies held at Bhopal on Nov. 22-23, 1996. The Chief Minister of MP Shri Digvijay Singh inaugurated the workshop. Rural Development Unit of CSIR in collaboration with RRL, Bhopal and CSIR Polytechnology Transfer Centre, Bhopal, organised the workshop and fifteen CSIR laboratories participated. The event attracted a large number of MP State Govt. agencies, NGOs and local entrepreneurs.

Four major seminars/workshops were organised by at the laboratory. A Technology Mission of Confederation of Indian Industries (CII), Western Region to RRL was a landmark. Under the auspieces of IIM and MRSI chapters RRL arranged formal interactions with industries associations in the region. RRL was privileged to receive a large number of distinguished visitors. Dr. A.P. Mitra, Former DGCSIR delivered CSIR Foundation Day (1996) lecture. Prof. S.K. Joshi, Former DGCSIR inaugurated a Resources Development Centre at the Laboratory.

A conscious effort was made to sustain high professional standards through research publications and interaction with experts, sponsoring agencies. National awards including a National Mineral Award were bagged by RRL Scientists.

RRL records sincere appreciation of the support received from Govt. Depts., agencies and industry who have sponsored a large number of R&D assignments.

RRL is especially indebted to Dr. P. Rama Rao, Chairman, Research Council, Dr. R.A. Mashelkar, Director General CSIR, members of Research and Management Councils for providing directions to the R&D endeavour. The guidance received from CSIR Head Quarters has been very valuable to the laboratory.

Scientists and staff of RRL have put in dedicated work towards development and progress of the laboratory.

(T.C. RAO)
Director

निदेशक का प्रतिवेदन

वर्ष 1996-97 हेतु वार्षिक प्रतिवेदन प्रस्तुत करना एक विशेषाधिकार है. इस कालावधि में क्षे.अ.प्र. भोपाल ने 24 मिलियन रु. से अधिक का बाह्य केश फ्लो अर्जित किया. इस लगातार अर्जन से बाह्य केश फ्लो आवर्ती व्यय के तुल्य हुआ है. अभिकरणों, विभागों एवं उद्योगों के द्वारा प्राप्त लघु कालावधि की परियोजनाओं से प्राप्त साख से वृहद परियोजनाओं की प्राप्ति हेतु मार्ग प्रशस्त हुआ है.

विभिन्न वृहद् क्षेत्रों जैसे भवन निर्माण, धातुकर्म एवं निर्माण विज्ञान, खनिज स्रोत विकास एवं पर्यावरणीय अध्ययन में क्षे.अ.प्र. ने संविदा अनुसंधान परियोजनाओं, परामर्शदाता एवं अन्य सुपुर्द जिम्मेदारियों के निर्वहन हेतु आकर्षण पैदा किया है. क्षेत्रीय विकास हेतु इन विभिन्न गतिविधियों में प्रौद्योगिकी विकास, अनुप्रयुक्त अनुसंधान, विशिष्ट तकनीकी सेवाएं एवं विज्ञान एवं प्रौद्योगिकी सम्मिलित है.

क्षे.अ.प्र. ने रेशम के खेतों में सिंचाई प्रबंधन हेतु राज्य रेशम संचालनालय द्वारा प्रायोजित समनुदेशनों को लिया है जिसमें चुने हुए रेशम के खेतों में जल प्रबंधन एवं मध्य प्रदेश के राजगढ़, बिलासपुर एवं सरगुजा जिलों में सिंचाई शक्ति का विकास है. राज्य शासन द्वारा चलाये जा रहे राजीव गांधी जलग्रहण विकास मिशन के अंतर्गत रायसेन जिले में जलग्रहण विकास परियोजना भी क्षे.अ.प्र. द्वारा कार्यान्वित की जा रही है.

भवन सामग्री के क्षेत्र में क्षे.अ.प्र. सॉफ्टवेयर पैकेजेस का उपयोग कर एकीकृत घटक अभिकल्पन, खनिज वूल पेनल्स, उड़न राख से निर्मित ईंटे, काष्ठ प्रतिस्थापन जैसे कार्य भी लगातार कर रहा है. प्रीकास्ट छते, काष्ठ प्रतिस्थापन में नवीन सामग्री, मिट्टी की उड़न राख ईंटे एवं रेड मड सीमेंट बाइंडर आदि से निर्मित सोलह अपार्टमेंट का निर्माण कार्य भी पूर्ण हो चुका है. यह समस्त कार्य राष्ट्रीय भवन संगठन के सहयोग से किया गया.

क्षे.अ.प्र. के विकास एवं अनुसंधान कार्यों का उद्भवन वर्तमान दक्षताओं एवं तकनीकी क्षेत्रों से

संपर्क जैसे मेटल मेट्रिक्स कम्पोजाइट्स, एफ.आर.पी. कम्पोनेन्ट्स, भूतल अभियांत्रिकी खनिज एवं कृषि औजार से निष्पादन सुधार आदि के माध्यम से हुआ है.

प्रयोगशाला ने तेईस नवीन परियोजनाएं विभिन्न क्षेत्रों में प्रारंभ की है जिसमें खनन औजार मशीनिंग में समुन्नत सामग्री, कृषि औजार, भूतल, अभियांत्रिकी, नवीन कोयला निर्माण एवं लाभकारी प्रौद्योगिकीय कृषि–भूमि के विकास में उड़न–राख के अनुप्रयोग पर्यावरणिकी अध्ययन एवं जल स्रोत प्रबंधन के क्षेत्र सम्मिलित है. वर्ष के दौरान बीस परियोजनाएं पूर्ण की गयी.

क्षेत्रीय विकास में विज्ञान एवं प्रौद्योगिकी के अधिकाधिक उपयोगों को दर्शाने हेतु वै.औ.अ.प्र. ने अपनी प्रतिबद्धता को भोपाल में 23-24 नवम्बर, 1996 को ग्रामीण प्रौद्योगिकी विषयक कार्यशाला सह प्रदर्शन के माध्यम से जाहिर किया. इस कार्यशाला का उद्घाटन म.प्र. के मुख्यमंत्री श्री दिग्विजय सिंह के द्वारा हुआ. वै.औ.अ.प. की ग्रामीण विकास इकाई, क्षे.अ.प्र. भोपाल एवं वै.औ.अ.प. बहुप्रौद्योगिकी हस्तांतरण केन्द्र भोपाल के संयुक्त प्रयासों से इस कार्यशाला का आयोजन हुआ एवं इस कार्यशाला में वै.औ.अ.प. की 15 प्रयोगशालाओं ने हिस्सेदारी की. इस कार्यशाला के माध्यम से म.प्र. सरकार के अभिकरणों, गैर सरकारी संगठनों एवं स्थानीय उद्यमी आकर्षित हुए.

प्रयोगशाला द्वारा चार मुख्य संगोष्ठियाँ/कार्यशालाएँ आयोजित की गयी. पश्चिम क्षेत्रीय भारतीय औद्योगिक महासंघ (सी.आई.आई.) का क्षे.अ.प्र. में आगमन उल्लेखनीय रहा.

आई.आई.एम. एवं एम.आर.एस.आई. चेप्टर्स के तत्वावधान में क्षे.अ.प्र. ने औपचारिक संवाद की व्यवस्था की. क्षे.अ.प्र. को कई विशिष्ट अतिथियों के आगमन का गौरव प्राप्त हुआ जिनमें डॉ. ए. पी. मित्रा, पूर्व महानिदेशक वै.औ.अ.प. ने परिषद् के स्थापना दिवस (1996) के अवसर पर व्याख्यान दिया. प्रो. एस.के. जोशी, पूर्व महानिदेशक, वै.औ.अ.प. ने प्रयोगशाला में स्रोत विकास केन्द्र का उद्घाटन किया.

प्रायोजक अभिकरणों, अभिकरणों, विशेषज्ञों के साथ संवाद एवं अनुसंधान प्रकाशनों के माध्यम से उच्च व्यावसायिक मापदंडों के निर्धारण हेतु विशेष प्रयास किये गये. क्षे.अ.प्र. के वैज्ञानिकों द्वारा राष्ट्रीय पुरस्कार एवं राष्ट्रीय खनिज पुरस्कार प्राप्त किये गये.

अभिकरणों एवं उद्योगों द्वारा प्रदत्त सहयोग हेतु क्षे.अ.प्र. उनका कृतज्ञ है जिन्होंने बड़ी मात्रा में अनुसंधान एवं विकास हेतु समनुदेशन प्रायोजित किये.

अनुसंधानात्मक एवं विकास कार्यों में दिशा –निर्देश प्रदान करने हेतु क्षे.अ.प्र. अनुसंधान परिषद् के अध्यक्ष डॉ. पी. रामाराव, वै.औ.अ.प. के महानिदेशक डॉ. आर.ए. माशेलकर अनुसंधान एवं प्रबंध परिषद् के सदस्यों का विशेष रूप से ऋणी है. वै.औ.अ.प. मुख्यालय से प्राप्त मार्गदर्शन भी प्रयोगशाला के लिए बहुमूल्य रहा.

क्षे.अ.प्र. भोपाल के सभी वैज्ञानिक एवं कर्मचारी प्रयोगशाला के विकास एवं प्रगति के लिए पूर्व निष्ठा से कार्यरत रहे.

टी. सी. राव

(टी.सी. राव)

निदेशक

Executive Summary

7.	M/s Elcaps Ltd. Mandideep	25.01.95	Technology transfer on Low voltage electrolyte.
8.	M/s Permali Wallace Ltd. Bhopal.	07.02.95	Technology transfer on FRP gear case.
9.	M/s Bharat Zinc Ltd. Bhopal.	24.03.95	Collaborative project on Leachable mangnous oxide for pyrolusite.
10.	M/s Optel Telecom Ltd. Bhopal.	14.08.95	Consultancy project of effluent treatment plant.
11.	M/s Environmental Technologies (India) Ltd. Nagpur	08.09.95	MOU for providing support as technological institution on environments related projects.
12.	M/s M.P. State Industries Corpn. Bhopal	28.09.95	R-wood doors panels etc.
13.	M/s Dual Build Tech, Madras & Visual Group of Co. Madras	10.10.95	R-wood doors panels etc.
14.	National Fertilizer Ltd. Vijaipur District Guna	01.11.95	Impact of treated effluent on ground water quality.
15.	Rajiv Gandhi Gramodyog Mission Bhopal	19.02.96	EIA studies for Bhopal leather comple
16.	IMS Consultancy Services (A division of IMS Ship Management Ltd.) Mumbai	04.09.96	For joint projects and consultancy in environmental studies.
17.	M/s Parag Fans and Cooling Systems Ltd Dewas	28.02.97	Development and commercialisation of high efficiency axial flow aerodynamic FRP fan for cooling towers.

STAFF AS ON 31.03.97

Scientist Gr. IV	:	48
Scientific & Technical Staff Gr. III	:	19
Scientific & Technical Staff Gr. II	:	16
Scientific & Technical Staff Gr I	:	06
Total	:	89

Administration Gr. A	:	02
Gr. B	:	04
Gr. C	:	15
Gr. D	:	11
Total	:	32

Total Staff : 121
Research Fellows, Project Fellows, Project Assistants : 65

MAJOR FACILITIES AND SERVICES OFFERED

RRL has modern equipment and instrumentation for chemical analysis, minerals processing, mechanical testing and metallography in addition to well-equipped foundry, workshop and Library. The equipment include: [Scanning Electron Microscope, X-ray Diffractometer with PC-APD software, TAS Plus Image Analyzer, Atomic Absorption Spectrometer, DCP Spectraspan, Simultaneous Thermal Analyzer, Particle Size Analyzer], INSTRON Universal Testing Machine, Stress Rupture Testing Machine, Friction and wear Test Machine, Rubber Wheel Abrasion Tester, Gas Jet Erosion Tester, Bearing Test Rig, Talysurf Apparatus, Fatigue Testing Machine, Melt Spinner, 150 T Hydraulic Press, High Temperature Furnace, Plasma Spray Unit, Computerised Hysrerisisgraph, Magnetic Particle Test Equipment, Ultrasonic Flow Detector QFT 2 +, Ultrasonic Thickness Gauge DME DL, Portable Non-contact Thermometer, Portable Hardness Tester, Vibration Meter.

Leaf Area Index Meter (ELE International AM 100), UV-Spectro Photometer (GBC-911), Moisture Measuring System (6050 X 1 trase - USA), Portable Soil Analysis Kit (Palintest - 5000 ELE International).

Orion Ion Analyser (Model 290 A), High Volume Sampler, Weather Monitoring Kit, Stack Monitoring Kit, Zero Head Space Extractor, Portable Spectro Photometer (Hach DR/2000), Gaschromatograph Mass Spectroscope (GCMS).

Mozely Multi-Gravity Separator, Wilfley Table, Water-only Cyclone, Heavy Media Cyclone, Vorsyl Separator, Flotation Cells and Columns, Air-sparged Hydrocyclone, Kelsey Jig, Computer facilities.

Time Domain Reflectometre-Soil Moisture Measuring System, Guelph Permeameter.

RRL has acquired state-of-art computational power by procuring a SUN SPARC station and 16 numbers of PC-AT-486 machines. A thick ethernet cable back bone has been laid to cover whole laboratory and connected by five hubs for connecting the nodes. A network laser printer is connected to the LAN for remote printing. On the electronic mail front one 386 machine is linked to National Informatic Centre, New Delhi via local NIC office using their VSAT. This facility is being extended to all the users on the netwo through TCP/IP connectivity for e-mail and Internet browsing.

A centre for characterisation of Building Materials is set up at RRL with support from the Buildi Materials Technology Promotion Council (BMTPC) of Min. of Urban Development, Departm of Science and Technology and CSIR.

SERVICES OFFERED

Consultancy services and technical services comprising testing and analysis, training, assistar of advisory nature, etc. are extended. Major areas are specialised materials testing, engineeri failure analysis, building materials characterisation, minerals processing, environmental imp assessment, environmental auditing, safety auditing, hydrogeological investigation, effluent treatm plant design and user specific software development.

RRL has taken steps to make efforts to organise the calibration of instruments and measuring gaug This is being taken up to extend calibration and testing services to a large segment of BH ancillaries. Accordingly facilities for dimensional and force calibration are being set up. The facili will be accredited under NABL scheme of DST.

LINKAGES

Central Govt. Depts., Agencies, Institutions

Department of Mines, Indian Bureau of Mines, Department of Science and Technology, Departm of Atomic Energy, Ministry of Urban Development, Housing and Urban Development Corporati Indian Space Research Organisation, Defence Metallurgical Research Laboratory, Indian Cou of Agricultural Research, Central Institute of Agricultural Engineering, Central Ground Water Bo National Bank for Agricultural and Rural Development, Indian Institute of Science, Indian Sch of Mines, Building Materials and Technology Promotion Council, Central Public Work Departm National Building Organisation, UNICEF.

Madhya Pradesh State

Madhya Pradesh Council of Science and Technology, Madhya Pradesh State Mining Corporation, Water Resources Department, Public Health Engineering Department, District Administration in Tribal Regions, Rajiv Gandhi S&T Mission Directorates, Environmental Planning and Coordination Organisation, Tawa Ayacut Development Authority, Madhya Pradesh Electricity Board, Directorate of Sericulture.

Industrial Sector including PSE's, private and local industry

Bharat Heavy Electricals Limited, Bhopal; National Aluminium Company, Bhubaneswar; Central Mine Planning and Design Institute Limited, Ranchi; National Thermal Power Corporation, Rihandnagar and Ramgundam; National Fertilizers Ltd., Guna; National Mineral Development Corporation, Hyderabad; Hindustan Zinc Limited, Udaipur; TISCO, Jamshedpur; M/s Orient Cerwool Limited, Lakhtar; M/s Permali Wallace Limited, Bhopal; M/s Diamond Cements Ltd. Damoh; M/s Rasmi Diecasting Ltd. Hyderabad, M/s Atlas Automotive Components Ltd. Pune, M/s Bharat Zinc Limited. Bhopal, M/s Elcaps Ltd. Bhopal, M/s Optel Telecommunications Limited, Bhopal, M/s Environmental Technologies (India) Ltd. Nagpur.

CSIR Institutions

National Environmental Engineering Research Institute, Nagpur, Indian Institute of Chemical Technology, Hyderabad, Central Leather Institute, Madras, Central Building Research Institute, Roorkee.

LIST OF PROJECTS

Ongoing Projects in Metallurgy & Materials

S.No.	Project Title	Sponsor	Date of start
1.	Development of aluminium metal composites for Aerospace applications.	ISRO	July'91
2.	Metallurgy and process dev. for quality upgradation for better performance of critical parts of Agr. machinery.	ICAR	Jan.'93
3.	Process development on a semi-commercial level for ceramic performs.	OCL	May'95
4.	Improvement in the Rejuvenation technique for clogged tubewells by employing non-toxic chemical cleaning.	RGNDW	April'95
5.	Effect of rate of deformation on magnetic anisotropy of Nd-Fe- B alloy.	INDO-US	Sept.'95
6.	Analysis of interlayer bonding for making sound trimetallic thrust bearing for hydro-generators.	BHEL	Aug.'95
7.	To investigate the possibility of indigenisation of retaining rings for the use in high voltage high speed squirrel cage.	BHEL	Aug.'95
8.	Evaluation and life extension of electrostatic precipitators ATPS Chachai.	MPEB	Oct.'96
9.	Inspection of steel structure of impregnation plant.	HEG	May'96
10.	Development of energy and cost effective materials for mining industries.	DOM	Nov.'96
11.	Surface modification and re- conditioning of farm implements for improved performance.	ICAR	Oct.'96
12.	Stability test of various structural at Korba East.	MPEB	Apr.'97
13.	Failure investigation of rope way coal conveyor system at Korba East.	MPEB	Apr.'97

Ongoing Projects in Building Materials, Natural Fibres, Polymers, Waste Utilization

S.No.	Project Title	Sponsor	Date of start
1.	Building materials characterisation and testing centre	BMTPC	April'95
2.	Development of photoclear flexiglass moulding	BHEL	April'94
3.	A study on mechanical properties of sisal fibre produced in M.P.	MPCST	Aug.' 92
4.	Standardisation of test method for quality check of mica epoxy tape	BHEL	Aug.'95
5.	Development of decorative furniture from stone dust/powder non-abrasive paint from Agate	BMTPC	April'96
6.	Integrated approach for design and development of FRP building components	BMTPC	May'96
7.	Long term effect of fly ash on soil fertility and crop yield	DST	May'96
8.	Wasteland development by flyash application at Angul & Damanjodi in Orissa	NALCO	May'96
9.	Chemical and biological screening of medicinal plants from Bastar Dist. M.P.	MPCST	Mar.'97
10.	Development of M-wood	BMTPC	Jan.'97
11.	Development/training of value added products from natural fibres of M.P.	MPCST	Nov.'96
12.	Investigation of soils for clay bricks and upgradation of brick industries in M.P.	BMTPC	Feb.'97

Ongoing Projects in Water Resources Management, Groundwater Modelling, Contamination

S.No	Project Title	Sponsor	Date of start
1.	Micro level study on water-logging problem at Kharar village Seoni-Malwa block Hoshangabad dist. M.P.	TADA	April'94
2.	Groundwater balance studies in dark areas with special reference to Sanwer block Indore M.P.	NABARD	Sept.'94

3.	Development of monitoring mechanisms for watershed development activities in 37 DPAP/ EAS districts	RGMWD	June'96
4.	Detection in miniaturized separation systems	EC	July'94
5.	To predict impact on groundwater quality due to long term application of treated effluent on land at NFL Vijaipur	NFL	Nov.'95
6.	Plan document preparation and implementation in milliwatershed management under Rajiv Gandhi Mission for Watershed Development	DRDA	Jan.'96
7.	Water Management in selected sericulture farms in Bilaspur Raigarh & Sarguja dist. of M.P.	Dept.of Sericulture	Mar.'97
8.	Development of irrigation potential in sericulture farms of Bilaspur, Raigargh & Sarguja Dist. of M.P.	Dept.of Sericulture	Mar.'97

Ongoing Projects in Minerals, Coal Preparation, Environmental Studies

S.No.	Project Title	Sponsor	Date of start
1.	Studies on separation characteristics of Dynawhirl Pool treating coal	DST	Apr.'95
2.	Performance evaluation of Air sparged hydrocyclone to treat Indian coal fines	CMPDIL	Apr.'95
3.	Industrial applications of Vorsyl separator in BCCL Coal washery	CMPDIL	Apr.'95
4.	Industrial applications of Vorsyl Separator in CCL	DST	Apr.'95
5.	Studies on entertainment in froth flotation of fine coal	NSF	Oct.'95
6.	Installation of plant scale water only cyclone a Jamadoba washery	TISCO	Mar.'9
7.	Installation of 24" Vorsyl separator at West Bokaro washery-II	TISCO	Apr.'9
8.	Optimisation studies on Multi-gravity separator at Rajpura-Dariba Mines	HZL	May'9
9.	Separation of lead and graphite using water only cyclone	HZL	June'9

10.	Advisory consultancy to the Hutti Gold Mines Company Ltd. Banglore	HGML	Oct.'96
11.	EIA for proposed leather complex at Adampur	RGGM	Nov.'95
12.	Rapid and comprehensive EIA studies for proposed 25 MW captive power plant at Indore	SIASL	May'96
13.	Environmental impact assessment for proposed LPG storage facilities at Porbander	IMSPL	May'96
14.	Investigation of laboratory multi-gravity separator (MGS)	HCL	Sept.'96
15.	Advisory Consultancy to M/s TEGA India Limited	TEGA	Aug.'96
16.	Environmental audit studies for ammonia and urea plants of RCF Thal Alibag Dist. Raigarh	RCF	Feb.'97
17.	In-situ whisker reinforced ceramic matrix composites for high temperature engineering applications	ARDB	Feb.'97
18.	Value addition of Indian China clays by modern benefication methods	GMDC	Apr.'97

Dr. R.A. Mashelkar, DGSIR laid Foundation of Housing Colony.

R & D PROGRAMMES

The Laboratory made a concerted effort to consolidate its R&D areas which were enunciated in the early 90's by the RC. A steady phase of building up credibility through short term projects funded by user agencies and departments, industry, is now consciously paving way to larger projects and sustainability to the R&D areas. In the broad framework of major disciplines of **Building Materials, Metallurgy & Materials Science, Minerals, Resources Development and Environment,** the Laboratory is now poised to carve out niche areas. The range of activities encompasses technology development, applied research, specialised technical services and S&T applications in regional development.

BUILDING MATERIALS

RRL has consolidated a strong base for development of low cost/alternate building.materials and components. These include the following:

- **Development of red mud/fly ash based wood substitute material.**
- **Development of red mud cementitious binder.**
- **Fly ash bricks with a variety of soils, upgradation of brick industries in M.P.**
- **Use of natural fibres in low cost housing.**
- **Demonstration houses with innovative materials and technologies.**
- **Materials evaluation and characterization, component design.**

The projects. carried out by the Laboratory have attracted a major funding from Ministry of Urban Development, Building Materials Technology Promotion Council, Department of Science & Technology, National Building Organisation.

To enable mass application of products like wood substitutes, clay fly ash bricks **license agreements** have been made and the licensees have been provided a major technical back up to facilitate technology development assistance from financial institutions.

Prototype Houses

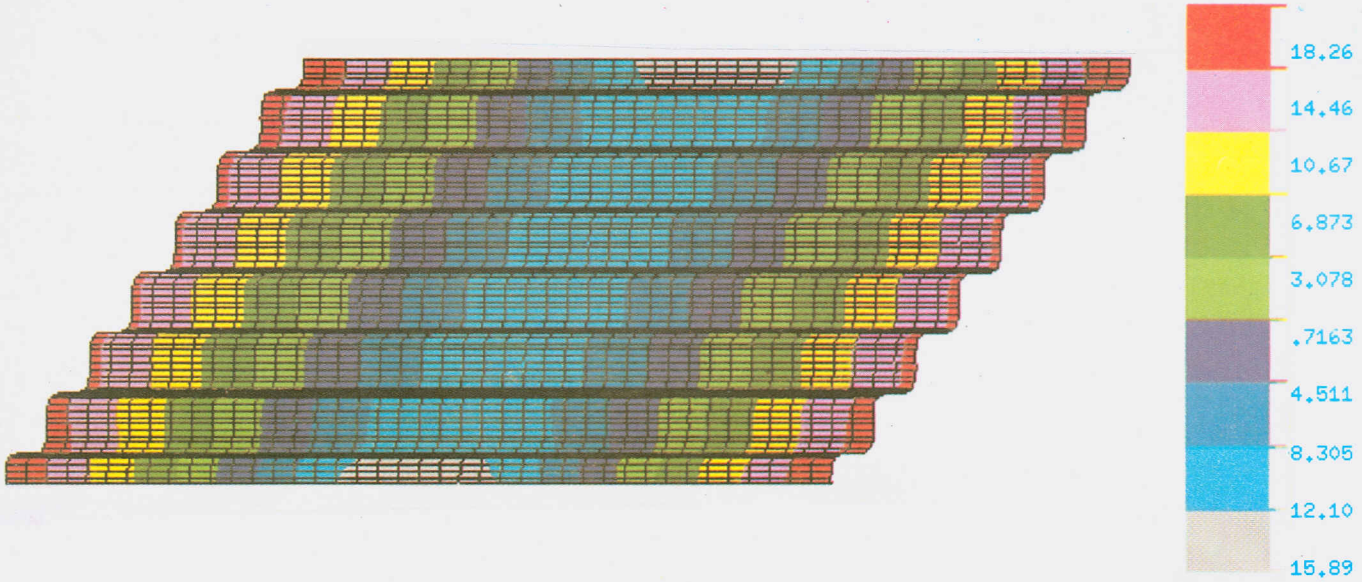
National Building Organisation, New Delhi and CSIR funded a project to construct sixteen proto houses using new materials and techniques. This scheme was conceived for carrying out field t of new techniques in demonstrating the "Know-how" by converting it to "Show-how" in the fi The construction of prototype houses is a landmark development involving use of new build materials and techniques developed by the laboratory. It has been possible to effect overall reduc in the cost of construction, including saving in materials. There is about 15 % saving in cos adopting these new technologies/materials and 12 % saving in total cost of construction.

Shri K.S. Sharma, Union Secretary, Dept. of Urban Employment & Poverty Alleviation, inaugurated prototype houses built by RRL under NBO support, using innovative techniques and materials.

A cementitious binder based on red mud waste from aluminium industry has been used in concrete for foundation and stone masonary. Clay fly ash bricks produced by RRL, Bhopal been used in superstructure. Precast RCC slabs developed by CBRI Roorkee have been use roofing. R-Wood, eco-friendly and hundred percent wood substitute developed by RRL, Bhop used for door shutters. There are two blocks, each having eight flats. The total plinth area of flat is 850 square feet including common areas.

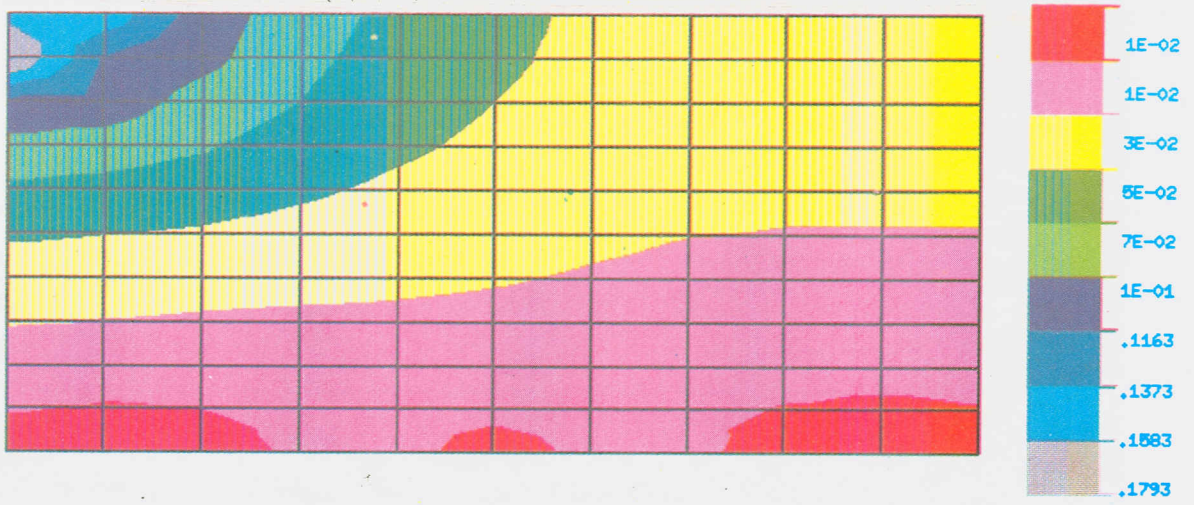
Building Materials Characterisation Centre

Building Materials Characterisation and Testing Centre has been set up at RRL under joint sponsorship of BMTPC, DST and CSIR. This facility is intended to cater to the needs of materials evaluation, testing and is backed up with modern computational facilities including FEM software support. It is proposed to undertake major commercialisation and marketing activity for specialised testing and evaluation services for the building materials sector.



Finite element analysis of red mud polymer corrugated roofing sheet showing stress pattern in Y-direction.

The analysis of red mud fibre polymer door shutter and red mud fibre composite corrugated roofing sheet have been done using "Finite Element Analysis of Structures" (FEAST) and "Numerically Integrated Structural Analysis (NISA)" software. The design procedure through these packages have improved the reliability of the components. Further the design has optimized the structure and led to weight reduction.



Finite element model of RMP door shutter showing streeses under edge loading test.

METALLURGY AND MATERIALS

The Laboratory activities in this area have been in following broad classifications:

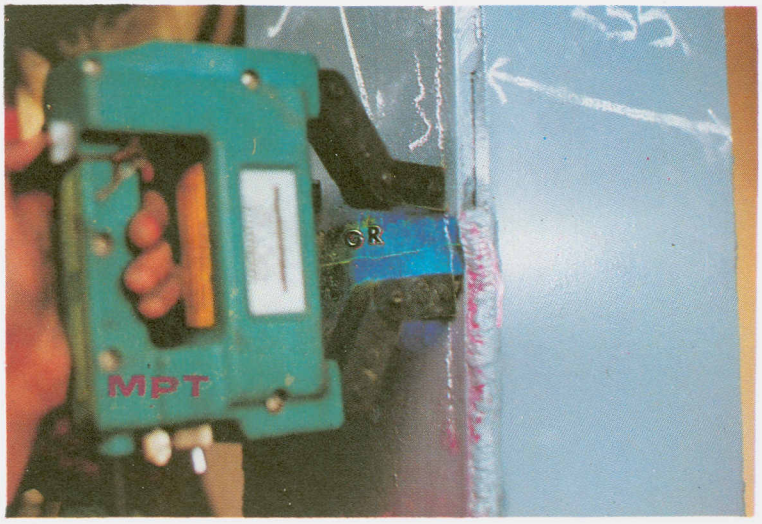
- **Composite materials including MMCs, Ceramic fibre reinforcements, FRP mate**
- **Upgradation of mining and farm implements for improved performance and life**
- **Metallurgical failure investigations, particularly for power plant components, Re life assessment (RLA) and Life extension studies.**
- **Materials and process development e.g. trimetallic bearing pads, magnetic mat grinding media, squeeze casting, variable pressure shot control casting for alum alloys, Zinc-Al alloys, welding.**
- **Surface engineering.**
- **Consultancy, testing calibration and materials evaluation**

Formal linkages with industry and user agencies have been made for process development a semi-commercial stages, field trials and evaluation. Examples are Aluminium-SiCp brake ceramic fibre performs, Zinc-Al alloy bushes, FRP gear case for traction motors of diesel locom axial flow energy efficient cooling tower fans of FRP.

Failure Investigation and Life Extension Studies

Specialised technical services for failure investigations, remnant life assessment and life ex studies have attracted considerable attention and a major market is emerging.

Investigations on coal feed bunkers of Thermal Power Plant.

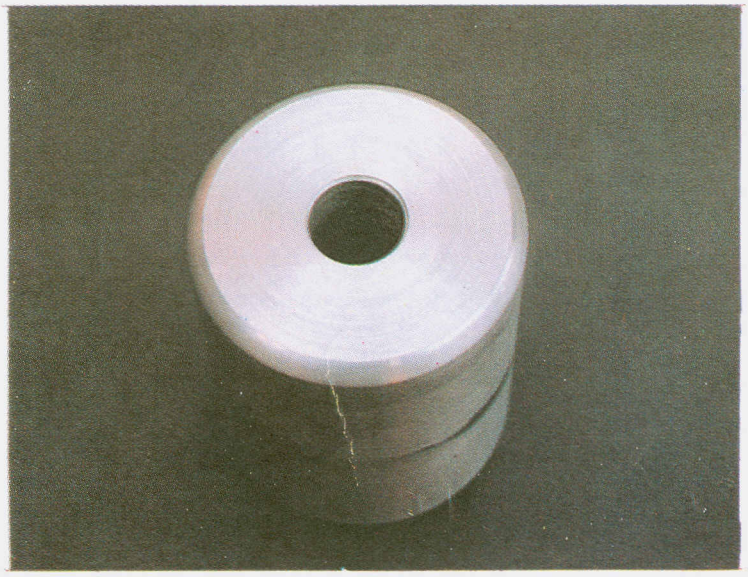


Magnetic particle test being performed for integrity evaluation of a structure; a well developed crack can be seen.

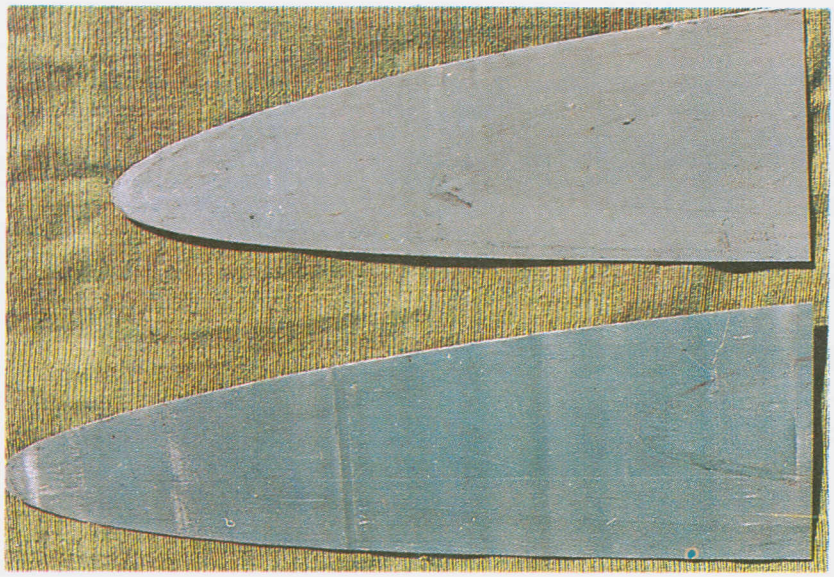
Advantages of failure investigation and life extension studies with reference to metallic components and structures in power plant and process industry sector are multifold. Higher availability, enhanced efficiency, operational flexibility and reduced maintenance costs are aimed for. RRL was called upon to carry out studies and investigations on various components and structures such as boiler tubes, coal feed bunkers, rotar shafts, ropeway trestles, electrostatic precipitators for various operation of M.P. State Electricity Board. Similarly, integrity evaluation of structure for impregnation plants, water treatment plant were also undertaken. Work was carried out for Diamond Cement Ltd., Damoh, National Fertilizers Ltd., Guna and HEG Mandideep.

Aluminium Alloy Based Composite

Aluminium alloy based composite brake drum developed by RRL was evaluated in Nissan Jonga



SiC whisker reinforced 2014 aluminium alloy matrix composite billets produced from ingots ready for extrusion



Rolled sheets of silicon carbide whisker reinforced aluminium alloy composite.

Jeep at VRDE, Ahmednagar. The performance of aluminium composite brake drums v better than the existing cast iron brake drum with respect to brake efficiency and temper Recently aluminium composite brake drums were fitted in a Maruti Van and tested at 10,000 kms. The performance evaluation studies give encouraging results and indicate p to extend the use of Al-composites in other automobile components like crankshaft, br connecting rods, piston, cylinder blocks etc.

Materials for Mining Industries

Mining industries in India are progressively looking forward to overcome problems assoc shorter life spans of equipment/implements because of higher wear rate. This leads to the co of large quality of materials and energy. One of the effective method to improve the life of c may be through the design and development of high performance material. Alumini matrix composites and Z-A alloys are light weight and possess improved wear resista project on "Development of Cost and Energy Effective Materials for Mining Industries" u at RRL and sponsored jointly by Ministry of Mines, Dept. of Science and Technology New Delhi following components are being studied:

Vortex finder, Refrax Apex Insert for Cyclones and Impeller and Inlet for Sala pumps to Al-alloy composites,

Bearing for shovel and other mining machinaries to be made of SLIZ alloys,

Improved materials for grinding balls for ore grinding.

Mined coal is associated with hard minerals like quartz, silicate; pyrites etc. which cause wear of coal-grinding components during pulverisation process. Presently, coal-grinding c

such as bull rings, grinding rolls etc. are made out of Ni-hard cast iron or high chromium ferrous alloys. The performance and service life of components can be extended by new materials or by improving the surface property of the existing materials through hard facing technique. Hard facing can improve performance of the components most economically by increasing the wear resistance of the surface and restoring the toughness of the core materials. A project on "Development of Alternate Materials for Coal-Grinding Components" has been undertaken.

Trimetallic Bearings

A process for trimetallic components for wear(bearing) applications has been developed by RRL. A thermally conducting layer of copper/copper alloy is inserted between a steel substrate and babbitt lining to bring about more efficient heat transfer in operation. Bimetallic bearings with steel backing overlayed with bearing lining are in use in variety of engineering applications. Such bearings are required in a large quantity by electrical, automobile, agricultural and other industries. The functional requirements of a bearing include load carrying capacity of the rotating assembly and good wear characteristics. These indicate minimum friction and wear of the components, less damage to the rotating assembly and faster rate of heat transfer generated during rotation as a result of friction between the bearing and the rotating components. The conducting layer between steel backing and bearing lining would enable rotating or sliding components to move at high speeds and thrust loads.

MINERALS AND COAL PREPARATION

With regard to mineral and coal processing RRL extends technical advise and consultancy for introduction of innovative techniques like Vorsyl separation, air sparged hydrocyclone column flotation. For this, there have been interactions and work undertaken for industry (TISCO), Department of Coal, CMPDIL and CIL. Similarly for beneficiation of non-metallic minerals and processing techniques particularly, RRL has developed a viable expertise for technical advise and trouble shooting.

Water-only Cyclone at Jamadoba Coal Washery

The run of mine coal when crushed for beneficiation, contains about 20 percent fines (below 0.5 mm). This fraction is generally treated by froth flotation process. Previous studies carried out at RRL on the efficacy of water-only cyclone for beneficiation of Sijua Group coal fines has shown its potential use. Based on this TISCO have funded a project for plant trials on 300 mm water-only cyclone. The unit has been fabricated and installed at Jamadoba Coal Washery and its trials are in progress. If the existing froth flotation process is replaced by water-only cyclone, there will be a large savings in reagents consumption, power and equipment maintenance.

Vorsyl Separator

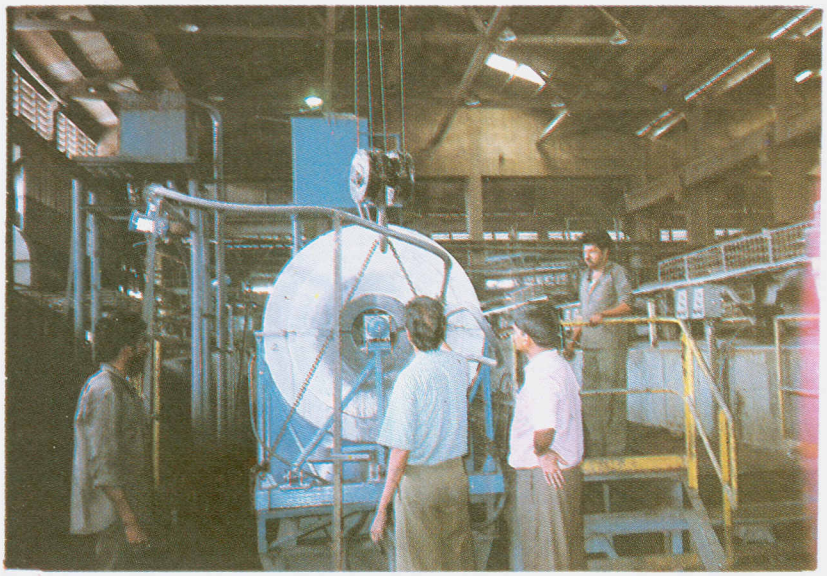
Extensive laboratory studies on heavy medium cyclone and Vorsyl separator were carried out. Subsequently in plant studies on 400 mm heavy medium cyclone and 400 mm Vorsyl separator at TISCO's West Bokaro Washery-I were undertaken. The results obtained from above studies showed superiority of Vorsyl separator over heavy medium cyclone.

To confirm the findings, TISCO, Dept. of Coal and Dept. of Science & Technology have further

funded the installation and plant trials on large scale Vorsyl Separator (500 mm and 600 m at West Bokaro Washery-II, Dugda and Sawang Coal washeries respectively. The tests Bokaro Washery-II confirmed a higher yield of clean coal at the desired ash content com the existing heavy medium cyclone in the washery. The installation and trials on this unit a (BCCL) and Sawang (CCL) coal washeries are in progress.

Studies on Multi-Gravity Separator at Rajpura Dariba Mines

Hindustan Zinc Limited faces with a problem of higher graphitic carbon in the lead concentrate. A study was carried out at RRL to reduce this impurity using Multi-Gravity S where in the graphitic carbon was reduced from 9.8 percent to less than 2 percent. Base study HZL has installed an industrial size double drum Multi-gravity separator at Rajpura Mines. The optimisation studies of this unit was carried out by RRL and it was possible t the graphitic carbon from 16 percent to 2 percent.



Based on the studies carried out by RRL a multigravity separator was installed at Rajpura Dariba mines of Hindustan Zinc Ltd.

Performance Evaluation of Air-Sparged Hydrocyclone to Treat Indian Coal Fines

The project funded by Dept. of Coal, Govt. of India has been completed successfully. The of the project was to evaluate the performance of air-sparged hydrocyclone (ASH) as al conventional froth flotation process. Three different coal samples have been tested a compared with that of conventional and column flotations. From the results the observations were made:

ASH is capable of producing clean coal having similar yield and ash content com conventional and column flotation.

It is necessary to recirculate the underflow of ASH to recover coarser coal particles.

ASH requires higher reagents dosage to get comparable yield as that of conventioanl and column flotation. However, tests carried out elsewhere using plant scale ASH unit have shown that the reagent dosage reduces drastically with larger ASH units. Extremely high levels of collector and frother dosages are detrimental to ASH flotation.

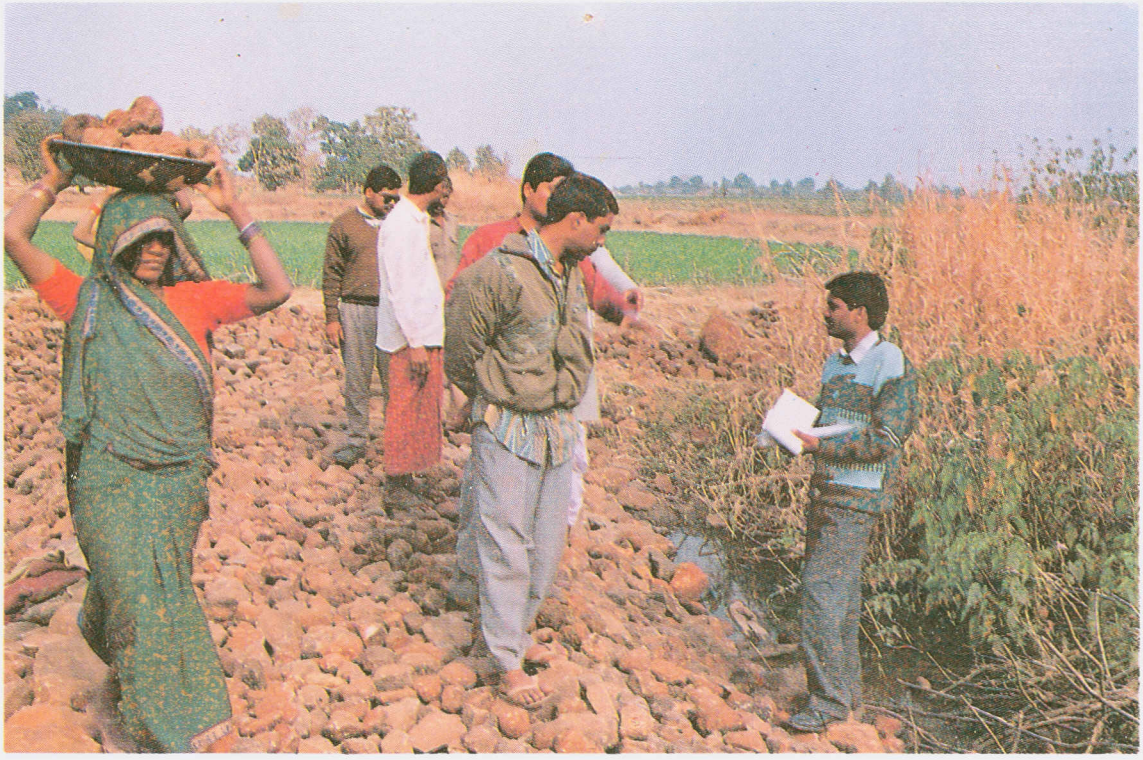
ASH offers considerable savings in floor space, process time and also has no moving parts, hence, less maintenance time.

RESOURCES DEVELOPMENT

Main capabilities in this area exist in Resources Modelling and Systems Analysis. The following are major activities in the area of Water Resources Management:

- **Groundwater Resources Management**
- **Groundwater Contamination Studies**
- **Watershed Development**
- **Land & Water Resources Management and Planning**

R&D projects with specific reference to local needs on water resources management, incorporating groundwater resources management, contamination studies and watershed development have been pursued. A major resource base for the Rajiv Gandhi S&T Mission of M.P. State Govt. on Watershed Development has been attempted during 1996-97.



Loose boulder check dams were made at Dabri village in Begumganj watershed.

To arrest soil erosion, cattle protect trenches were made at Dabri village under Rajiv Gandhi Mission for Watershed Development.

Guelph Permeameter was used in studies carried out at NFL, Guna.

Water Management and Development of Irrigation Potential for Sericulture

As a result of consistent efforts to bring together various agencies, drawing upon advise of several well-known experts in the area, and more importantly establishing credibility with user agencies, the laboratory has had a major break- through in the area of Water Resources Management for Sericulture Farms in M.P. The Directorate of Sericulture M.P., has sponsored two major projects:

- **Water Management in selected Sericulture Farms of Madhya Pradesh**
- **Development of Irrigation Potential in Raigarh, Bilaspur, and Sarguja Districts of Madhya Pradesh**

The first project aims to understand the physical framework and geological set up and to design the measures for improving irrigation facility in sericulture farms of various districts of M.P. These measures essentially involve enhancement of present water availability, through developing of source and by construction of cost effective water and soil conservation structures.

The next project aims to understand the physical frame work and geological set up in various sericulture farms for water management for mulberry plantations in three districts of M.P. namely, Bilaspur, Sarguja, and Raigarh. These districts are located in eastern part of Madhya Pradesh. The population of scheduled castes and tribes varies from 40% to 60% of total population in these three district. Per capita income in these districts is largely dependent on mono-cropping of paddy and a large rural population below the poverty line due to the lack of the employment opportunities, especially in non-farming season. Directorate of Sericulture has planned the Sericulture project in order to alleviate the poverty in the above three districts and to improve the status of women. The project aims at participation of local people particularly, women in soil and water conservation activities by imparting training on participatory role appraisal exercise for better usage of water and maintenance of structures.

Rejuvenation of Clogged Hand Pumps

Under the sponsorship of Rajiv Gandhi National Drinking Water Mission, Ministry of Rural Development, Govt. of India, a process for rejuvenation of clogged hand pumps has been developed where in the clogged wells are treated with a non-toxic chemical composition and hydro-fractured using high pressure, high velocity water. Using chemical-hydrofracturing process twelve clogged hand pumps located in different villages namely, Sonkachha, Golkhedi, Imalia, Parvalisonia, Itakhedi, Lamba Khedi, Dolatpur Thekari, Jhirnia, Tila Khedi and Ratibed, near Bhopal city have been successfully cleaned.

The success rate of chemical hydrofracturing process has been found to be about 90% with substantially high water yield from the cleaned wells.

Detection in Miniaturised Separation Systems

Experiments have been performed with precolumn derivatization for improved UV absorbance detection. Hydrazino benzene sulfonic acid (HBSA) has been selected as a new derivatization

reagent for carbonyl compounds with the formation of the corresponding hydrazones. Sepa conditions have been studied to obtain the maximum number of resolved peaks. Six ca compounds that are regarded as priority pollutants were separated in 12 min with a sepa voltage of 15 kv. The best signal-to-noise ratios for the various carbonyl derivatives were ob at 275 nm detection wavelength. Work on the further improvement of the separation and the de is in progress.

For the determination of aliphatic and aromatic amines with fluorescence detection, dansyl ch has been used as a precolumn derivatization reagent. Separation conditions have been stud was found that most of the derivatized amines have similar electrophoretic mobilities in fre electrophoresis. Variation of the pH or the use of organic modifiers had no effect. The presently the application of micellar electrokinetic chromatography is being studied. Preli experiments show that a separation is possible.

Furthermore, a start has been made with the study of the application of on-column derivatiza metal ions (Al, Ba, Ca, Cr, Cu, Mg, Pb, Zn) with EDTA. The on-column reaction leads formation of UV absorbing complexes. Reaction conditions have been optimised.

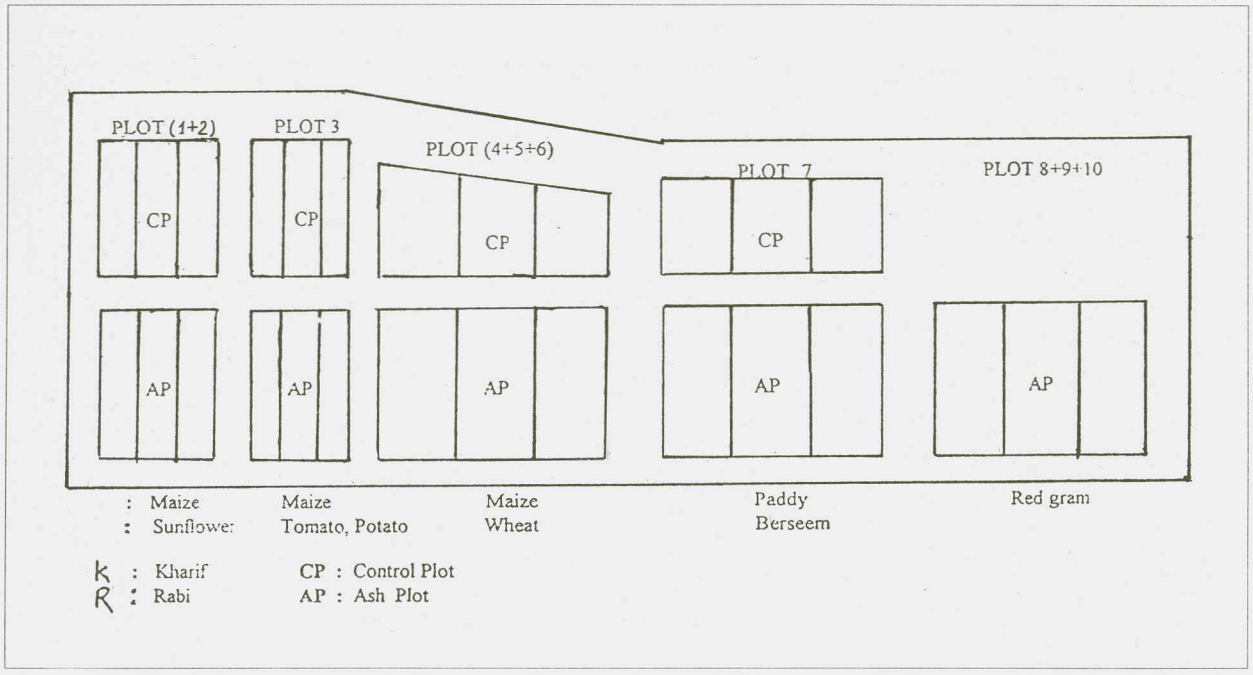
ECOLOGY ENVIRONMENT

In view of rapid industrialisation, the region of M.P. is expected to throw up challeng look for support in environmental impact assessment studies. Major opportunities are emer power sector in M.P. where a number of power stations are coming up in the private secto aspires to fulfill this immediate need by providing specialised technical and consultancy ser the industry.

In the area of flyash utilization, the laboratory has excelled in carrying out pilot level on bulk application for land development and soil modification. DST-TIFAC flyash Miss supported a major study for further analysis and long range impact. NTPC, Rihandnagar and power stations at Sarni, Korba have approached for taking up similar programmes. A cross fu group is set up in the Laboratory to evaluate contaminant movement in groundwater near ash d sites. This project is being supported by CBIP.

Flyash Utilization in Land Development

The pilot project on use of flyash for wasteland development, was successfully comp NTPC, Rihand Nagar (U.P.) in 1995. Further experiments have been undertaken to stu term effect of flyash in respect of soil fertility and food quality. In the rabi season, expe were carried out in all the plots of Dodhar & Nilgiri sites of Rihand Nagar following the p treatments of pond ash application and also with an additional treatment of T3 (i.e. 5 steps every year). Number of pilot plant studies have been carried out to improve the soil fer optimising the different concentrations of pond ash mixing with soil. In the experiment vegetables and crops are growing in the controlled plot as well as in pond ash fille These experiments will be carried out for two seasons to examine the effect of pond ash yield in successive cropping season.



A schematic of reclaimed land at Nilagiri site, NTPC, Rihandnagar.

NALCO has sponsored a similar project at Angul and Damanjodi in Orissa. The initial field studies have shown excellent results. In order to conduct the pilot scale demonstration with NALCO flyash for wasteland development, an area of 5.0 acres of plot has been selected. Crops, vegetables

Randomised plot design is followed at experimental site at Angul, NALCO.

are grown in controlled plot as well as in the flyash filled plot in the rabi season. Soil samples were collected from different plots before sowing of seeds to study the soil quality. After harvesting of these crops soil quality and food quality will be studied.

EIA for LPG Storage Facility

IMS Petrogas Ltd. is the first Private Sector company to set- up a LPG storage facility a Porbander. The total capacity of the LPG storage is 1,20,000 MT per annum. LPG is sto 1350MT Horton spheres for onward trasmission to LPG bottling plants across the cou is imported as a mixture of commercial propane and butane in pressurised tankers.

The scope of present study on Environmental Impact Assessment (EIA) included charac of the status of the environment in an area of 10 Km. radius from the project site for environment components viz., air, water, land, biological environment, noise and socio- enovironment.

EIA for 25MW Captive Power Plant of Ishar Alloys and Steels Ltd., Indore

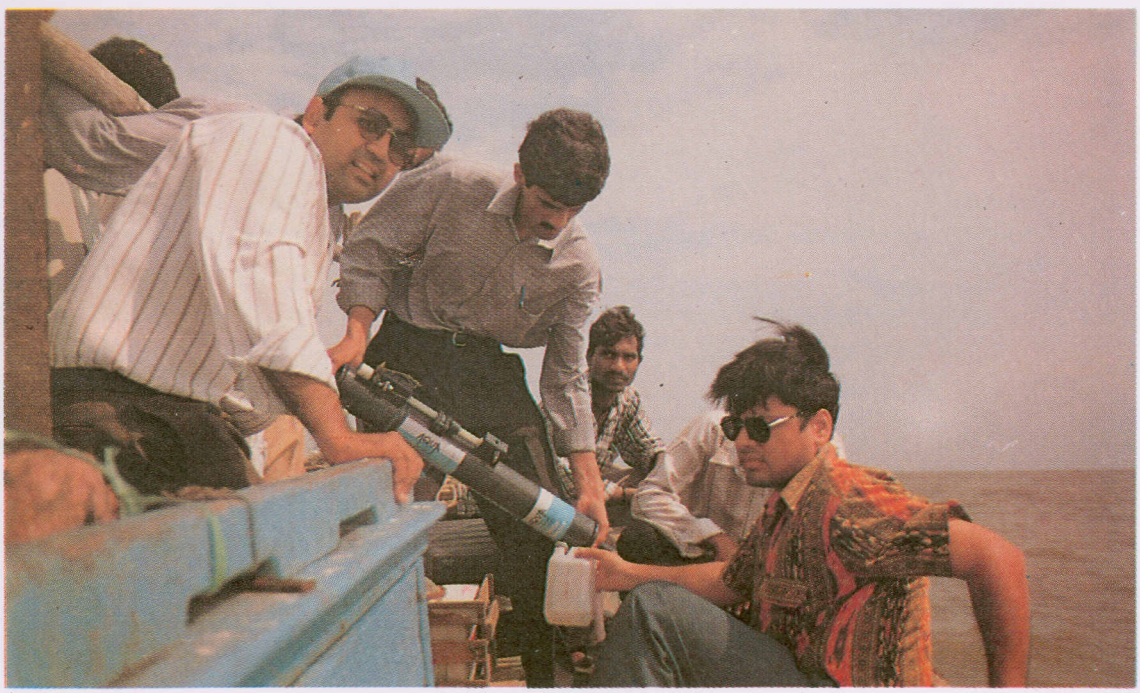
Shri Ishar Alloy Steel Ltd. (SIASL), one of the Shri Ishar groups of companies, was e in 1970, having present yearly turn over of Rs. 400 crores. The company located in Madhya Pradesh produces wide range of steel grades. In order to protect the man activities from the vagaries of power supply, SIASL has proposed installation of a 25 M Generator power plant. RRL has taken rapid EIA and comprehensive studies for the pr MW captive power plant using heavy fuel oil at Indore.

EIA for Proposed Leather Complex at Adampur, Dist. Raisen

Rajiv Gandhi Gramodyog Mission (RGGM) in collaboration with Leather Technolo (LTM) is to set up a Leather Complex near Bhopal. The proposed site is 25 Kms. Bhopal and situated at Pipalkhedia in Raisen District of Madhya Pradesh. The new site for setting up all the wet processes including tanneried gelatine, glue etc. Adampu cater for all the dry processes viz, marketing, finished products etc. Preparation of incorporating one season data and comprehensive EIA incorporating three seasons da progress.

EI & RA of Proposed Floating Hotel at Bandra Coast Mumbai

The proposed project is to study the environmental status and risk assessment at present and the impacts on it after the speciality Restaurant cum Hotel is established on the board of the strandedship M.V. Zhen Don off Carter Road, Bandra Sea Face, Mumbai. One season monitoring for air, soil, water and biological has been carried out.



Marine water sampling for FLOATEL, Mumbai.

Rapid and Comprehensive EI & RA for Proposed 120 MW Gas Turbine Based Powe at Marmugao, Goa

River water sampling at Goa for EIA of gas turbine based power plant

Reliance Industries Ltd. has proposed to set up a 120 MW gas turbine based power plant us Naphtha as the basic fuel for power generation at Marmugao Taluka of Goa.

RRL has been given the EIA studies for the above project. The main objective of these s preparation of rapid EIA report covering one season monitoring and comprehensive envir impact assessment report covering three season monitoring for different environmental con based on Ministry of Environment and Forests guidelines.

One season monitoring for air, water, land environment has been completed successfully an related to other components of environment such as biological, socio-economic is under

Environmental Audit Studies for Urea and Ammonia Plant of Rashtriya Chemi Fertilizers, Thal, Alibag, Dist. Raigarh

It is one of the major fertilizer producing industry with various unit operations/processing

during the production. RRL has been given environmental audit of the environmental management program. Preaudit phase, onsite audit phase has been completed and post audit phase which includes finalisation is under progress.

Stack monitoring at ammonia plant, primary reformer, RCF Thal Complex, Mumbai.

RURAL DEVELOPMENT

R&D projects with specific reference to local needs like water resources management and watershed development; extraction and use of natural fibres like sisal, sunhemp for handicrafts and also in building materials; medicinal plants; improved techniques for bell metal artifects and traditional metal making; rejuvenation of clogged tubewells in rural areas are some of the projects aimed towards rural development. The scope for S&T contributions is immense and is reflected in major lab projects in housing and construction; mines, minerals, metals and materials; ecology and environment.

- **Training of trainers amongst tribal women in preparation of herbal formulations, handicrafts based on sisal fibres has been undertaken. Training was also carried out in backward areas of Chhindwara district.**
- **Training programmes on bell metal technology were held for tribal artisans involved in the trade in MP, Bihar.**

GENERAL INFORMATION

Rural Technologies Workshop & Exhibition

Shri Digvijay Singh, Chief Minister of Madhya Pradesh inaugurated a two-day Workshop-cum-Exhibition on Rural Technologies at Bhopal on 22nd November 1996. Shri Singh called upon the scientists to develop newer technologies that would lead to value addition, and help in the economic upliftment of the rural people. He said that emphasis should be laid on those technologies that would enable the processing of raw materials produced in villages locally. This would increase employment opportunities in villages and help them become self-reliant. He also released a souvenir on "Rural Technologies for Madhya Pradesh" on this occasion. Presiding over the inaugural function, Shri Rajendra Prasad Shukla, Minister for Gramodyog, M.P. Government, pointed out that Madhya Pradesh is very rich in natural resources. Shri Tanwant Singh Keer, Minister of Local Self Government, delivered the valedictory address.

The workshop-cum-exhibition was organised by the Rural Development Unit of CSIR in collaboration with RRL and Polytechnology Transfer Centre (PTC), Bhopal. The objective of this workshop was to make the state government agencies, NGOs, local enterpreneurs and others aware of CSIR technologies for their utilization in the rural areas of Madhya Pradesh. Fifteen CSIR laboratories participated. Exhibits included various types of chulhas, baking/room-heating equipment, brick-making machine, different types of bricks/blocks, chalk making and corrugated sheet making equipment, precast building components and machinery Mini dal mill, leaf-cupmaking machine, potter's table, water analysis equipment, soil testing instruments, sisal fibre products, agricultural implements, and aromatic and medicinal plants and their products. Technologies related to wasteland development, rural road construction, etc. were also displayed. Technical Sessions were Conducted on Food Processing and Agro-based Industries, Medicinal and Aromatic Plants, Leather and Animal Products, Building Materials and Low-cost Housing, Drinking water, Environment and Sanitation, Pottery and Ceramics, Employment Generation Technologies, particularly those for Women, Support Systems.

CSIR Foundation Day

Regional Research Laboratory, Bhopal celebrated CSIR Foundation Day on Sept. 26, 1996. Dr. A.P. Mitra, an eminent Radio and Space Physicist and former Director General, CSIR was the guest of honour. Dr. Mitra delivered the Foundation Lecture on Radio Science in India. He also laid the foundation of a Seminar Hall Complex in the Laboratory. As a part of the Foundation Day celebration, the laboratory observed an "Open Day".

Dr. A.P. Mitra, Former DGSIR laid Foundation stone of a Seminar Hall Complex.

International Seminar on HPLC, CE

A three-day international seminar and short course on High Performance Liquid Chromatog (HPLC) and Capillary Electrophoresis was held from November 19, 1996. The ina session was presided over by the Principal Secretary of Science and Technology, Dr. Ajit R while Professor H. Poppe, from the University of Amsterdam (The Netherlands) delivered note address.

The programme was organised as a part of the joint research project undertaken by Bhopal under the scientific collaboration between commission of European Community Brussels, Belgium and Department of Science and Technology(DST).The project ai developing new detection methods for miniaturised separation system and HPLC has recognised as a significant and routine technique for the separation analysis of non-v compounds. HPLC has been accepted as reliable technique for separation of non-v compounds. This technique has found wide application in pharmacy, food control, medicin Similarly, CE is emerging as a potential alternative to HPLC. The course aimed at edu researchers with the basic concepts of HPLC and CE.

Fifty-five participants including scientists, quality control managers and researchers representing the industry, R&D institutions and universities attended the seminar and short course.

Under the European Commission project between RRL and University of Amserdam, Netherlands, International Seminar and Short Course on "High performance liquid chromatography and capillary electrophoresis" was held.

Programme on Maintenance of Bio-Medical Instruments

The eight weeks entrepreneurship development programme from Aug. 26, 1996 on repair and maintenance of bio-medical equipment was jointly conducted by Centre for Entrepreneurship Development Madhya Pradesh Bhopal, CSIO Chandigarh and Regional Research Laboratory, Bhopal. The programme was sponsored by National Science and Technology Entrepreneurship Development Board, New Delhi. Twenty five fresh Degree/Diploma Engineers were selected to participate in this programme from the various parts of the MP. Optel and Hamidia Hospital provided technical and instrumental services to the participants.

Shri Prem Narayan Thakur, Minister of Health M.P., was Chief Guest at the valedictory session of the Entreprenuership development programme on Maintenance of Bio-medical Instruments.

National Seminar on Tribo-Materials

A two day national seminar on tribo-materials was held at the Regional Research Labor Dec. 23-24, 1996. Shri R.C. Agrawal, GM, BHEL inaugurated the seminar. Prof. K.L. Director IIT, Kharagpur delivered key note for development of new materials which can c scarce resources and energy and are environment friendly. The seminar was organised un ageis of Materials Research Society of India, Tribology Society of India and RRL.

Shri R.C. Agrawal, GM Incharge, BHEL, Bhopal inaugurated the National Seminar on "Tribo-materials".

National Workshop on Materials Related Aspects of Thermal Power Plants

The Indian Institute of Metals, jointly with the Regional Research Laboratory and M.P. Council of Science and Technology, Bhopal organised a "National Workshop on Material Related Aspects of Thermal Power Plants" on June 12-13, 1996. The Workshop covered striking areas of current importance such as quality of coal used as a source of heat energy, water chemistry, materials performance and metallurgical failure analysis. Indian coal contains considerable amount of non-combustable constituents which has adverse effect upon combustibility of coal and on the performance of thermal power plant components. Experts in the field of water chemistry, coal preparation, metallurgical failure analysis and environmental aspects delivered special talks. The workshop also focussed on recycling of plant wastes like flyash for building materials, land development etc.

Resources Development Centre at RRL, Bhopal

Inauguration of Resources Development Centre at RRL by Prof. S.K. Joshi, Former DGSIR

A modern Resources Development Centre equipped with computational facilities and information technology tools was inaugurated at the Regional Research Laboratory (RRL), Bhopal, by Prof. S.K. Joshi, former Director General, CSIR, on 20 March 1997. Smt. Tinoo Joshi, Commissioner, Directorate of Sericulture, Government of Madhya Pradesh; Dr. Ram Prasad, Director General, M.P. Council of Science & Technology, Bhopal; Prof. T.C. Rao, Director, RRL, Bhopal; and a large number of invitees were present on the occasion.

National Science Day Celebrations

National Science Day celebrations were held in collaboration with the Regional Scienc (NCSM) Bhopal. Prof. T.C. Rao delivered a popular lecture entitled "Story of Coal and F at the Regional Science Centre. RRL also provided transport facilities to bring the p under previleged slum children for a visit to the Centre during the National Science Week function in RRL Bhopal, Shri M.N. Buch, Chairman National Centre for Human Settlem Environment delivered a talk entitled "India of my dreams", which was the theme of N Science Day Celebrations.

IEFMA National workshop on waste minimisation strategies.

A two day workshop was organised in collaboration with Indian Environmetal and Forest M Association (IEFMA), Bhopal on 17th-18th January 1997 at Udaipur. Regional Research Lab prepared a Handbook on Environmental information which was released during the wor Twenty six delegates attended the workshop and discussed on various waste minimisation st

APPENDIX-1

RESEARCH COUNCIL

Dr. P. Rama Rao — **Chairman**
Distinguished Scientist,
Defence Research & Development,
Room No.156, B-Wing, Sena Bhawan,
New Delhi-110 011.

Shri H.A. Ghanekar — **Expert**
Crompton Greaves,
Large Machines Division, Kanjur Marg (West),
Mumbai-400 042.

Dr. O.N. Mohanty — **Expert**
Director (R&D),
Tata Iron & Steel Company Limited,
Jamshedpur-831 001.

Prof. T.R. Ramachandran — **Expert**
Director,
Jawaharlal Nehru Aluminium Research
Development and Design Centre,
Opp. Wadi Police Station, Amravati Road, Wadi,
Nagpur-440 023.

Shri C.P.S. Nair — **Expert**
C/o Dr. S. Unnikrishnan,
Vrindavan,
C.P. Gopala Panicker Lane,
Sasthamangalam,
Thiruvananthapuram-695 010.

Dr. S.L.N. Acharyulu — **Agency/Deptt. Rep.**
Director,
Defence Metallurgical Research Lab.,
P.O. Kanchanbagh, Hyderabad-500 258.

Shri.K.S. Sharma — **Agency/Deptt. Rep.**
Chief Secretary,
Govt. of Madhya Pradesh,
Vallabh Bhawan, Bhopal.

Dr. T.N. Gupta — **Agency/Deptt.**
Executive Director,
Building Materials & Technology
Promotion Council (BMTPC),
G Wing, Nirman Bhawan,
New Delhi-110 011.

Shri R.N. Srivastava, — **Agency/Deptt.**
Member (Thermal),
Govt. of India,
Central Electricity Authority,
Ministry of Power,
Sewa Bhawan, R.K. Puram,
New Delhi-110 066.

Dr. Ram Prasad — **Agency/Deptt.**
Director General,
M.P. Council of Science & Technology,
Kissan Bhavan, Science Block,
26, Arera Hills, Jail Road, Bhopal-462 011.

Dr. C. Ganguly — **Sister-Lab.**
Director,
Central Glass & Ceramic Research Instt.,
P.O. Jadavpur University, Calcutta-700 032.

Prof. T.C. Rao — **Member (Ex-O**
Director,
Regional Research Laboratory,
Hoshangabad Road, Bhopal-462 026.

Dr. D.N. Misra — **DG's Nominee**
Emeritus Professor,
Central Institute of Fisheries Education,
7 Bunglaws, Varsova, Bombay-400 061.

Dr. R.N. Yadava — **Secretary**
Scientist EII,
Regional Research Laboratory,
Hoshangabad Road, Bhopal-462 026.

During 1996-97 Fourteenth and Fifteenth Meetings of the RC were held on April 8, October 11, 1996 respectively.

APPENDIX-2

MANAGEMENT COUNCIL

Prof. T.C. Rao Director, Regional Research Laboratory, Bhopal-462 026.	**Chairman**
Dr. A.D. Bhide Scientist, National Environmental Engg. Research Inst. Nehru Marg, Nagpur-440 020.	**Member**
Dr. A.K. Dubey Scientist CMRI Regional Centre, CBRI Roorkee-247 667.	**Member**
Shri S.K. Bose Scientist, Regional Research Laboratory, Bhopal-462 026.	**Member**
Shri P.D. Ekbote Scientist, Regional Research Laboratory, Bhopal-462 026.	**Member**
Dr. (Ms.) Mohini Saxena Scientist, Regional Research Laboratory, Bhopal-462 026.	**Member**
Shri J. Prabakar Scientist, Regional Research Laboratory, Bhopal-462 026.	**Member**
Sr. Finance & Accounts Officer Regional Research Laboratory, Bhopal-462 026.	Member
DGSIR or his Nominee CSIR Headquarters, New Delhi-110 001.	Permanent Invitee
Sr. Controller of Administration Regional Research Laboratory, Bhopal-462 026.	Member Secretary

During 1996-97 Twentyfirst meeting of the MC was held on August 9, 1996.

DISTINGUISHED VISITORS

Dr. R.A. Mashelkar, DGSIR, New Delhi, April 3, 1996.

Dr. P. Rama Rao, Distinguished Scientist, Govt. of India, Defence Research and Dev
Organisation, New Delhi and Chairman of RC, April 8, 1996.

Shri C.P.S. Nair, Trivandrum and Member of RC, April 8, 1996.

Shri. S.C. Behar, Chief Secretary, Govt. of M.P., Bhopal and Member of RC, April 8, 19

Shri H.A. Ghanekar, Executive Director, BHEL, Bhopal and Member of RC, April 8, 19

Dr. P.K. Jain, Dean, Gandhi Medical College, Bhopal, August 26, 1996.

Dr. P.K.B. Menon, Director, National Science and Technology Development Board (N
DST, New Delhi, August 26, 1996.

Dr. A.P. Mitra, FRS, Former Director General, CSIR, September 26, 1996.

Shri C.B. Turbde, General Manager, Rastriya Chemical and Fertilizers Ltd. (RCF), Mumba
1, 1996.

Shri M.G. Rao, Chief Engineer Rastriya Chemical and Fertilizers Ltd. (RCF), Mumbai, O
1996.

Shri P.C. Patnaik, Plant Manager, Rastriya Chemical and Fertilizers Ltd. (RCF), Mumba
1, 1996.

Shri Ranjan Dasgupta, President-Power, Crompton Greaves Ltd., Bombay, October 7, 19

Shri B.N. Kishore, Vice President (Technology), Crompton Greaves Ltd., Nasik, Octobe

Dr. Amit Ganguly, Dy. General Manager, R&D Division, Mukand Ltd., Thane, October

Shri R.S. Shah, Director (Technical), EMCO, Transformer Ltd., Thane, October 7, 1996.

Shri V.P. Warrier, Managing Director, Divya Industries Ltd., Bhopal, October 7, 1996.

Shri Y.S. Singh, Astt. General Manager, BHEL, Bhopal, October 7, 1996.

Shri Dipankar Roy, Deputy Director, Confideration Industries of India, Bhopal, Octobe

Shri K.S. Sharma, IAS, Union Secretary, Department of Urban and Poverty Alleviation, Govt. of India, New Delhi, November 12, 1996.

Dr. T.N. Gupta, DG, BMPTC, New Delhi, November 12, 1996.

Shri R.K. Celly, Chief Marketing, BMPTC, New Delhi, November 12, 1996.

Dr. Ajit Raizada, Principal Secretary, Department of Culture, Manpower Planning, Science and Technology, Govt. of M.P., Bhopal, November 19, 1996.

Prof. H. Poppe, Head and Dr. Wim Th.Kok, Laboratory for Analytical Chemistry, Amsterdam Institute for Molecular Studies, Amsterdam, The Netherlands, November 19-21, 1996.

Dr. Henk Lingeman, Free University, Amsterdam, The Netherlands, November 19-21, 1996.

Shri S.D. Garg, Adviser and Head, S&T Missions and Shri A.K. Bhatia, Joint Adviser, CSIR Hq., New Delhi, November 21-24, 1996.

Shri Wilfred Lakra, Chairman, Tawa Ayacut Development Authority and Commissioner, Bhopal and Hoshangabad Division, November 26, 1996.

Dr. S.N. Dwivedi, CSIR Emeritus Scientist, November 26, 1996.

Dr. S.K. Gupta, Principal Scientist, Central Soil Salinity Research Institute, Karnal, November 26, 1996.

Shri B.R. Singh, Director, Water and Land Management Institute, Bhopal, November 26, 1996.

Dr. N.S. Venkata Raman, Mission Director, Advanced Composites Mission, Technology Information Forecasting and Assessment Council (TIFAC) (DST), New Delhi, December 9, 1996.

Dr. Vimal Kumar, Director, TIFAC (DST), New Delhi, December 10, 1996.

Dr. P.N. Takkar, Director, Indian Institute of Soil Science, Bhopal, December 10, 1996.

Prof.(Mrs.) Padma Vasudevan, National Consultant, Rajiv Gandhi National Drinking Water Mission, December 12, 1996.

Dr. S. Biswas, Director, TIFA, Division, DST, New Delhi, December 12, 1996.

Shri R.C. Aggarwal, General Manager in-charge, BHEL, Bhopal, December 23-24, 1996.

Prof. K.L. Chopra, Director, Indian Institute of Technology (IIT), Kharagpur, December 23-24, 1996.

Prof. G.N. Mathur, Director, DMSRDE, Kanpur, December 23-24, 1996.

Dr. G. Singh, Director, Central Institute of Agricultural Engineering, Bhopal, December 1996.

Dr. Y.S. Rajan, Vice President, Confideration of Indian Industries (CII), New Delhi, Janu 1997.

Prof. J.K. Gillham, Polymer Science, Princeton University, USA, February 11, 1997.

Shri M.N. Buch, National Council of Human Settlement and Environment (NCHSE), February 28, 1997.

Prof. M.A.L. Thattachar, Indian Institute of Science, Bangalore, March 13, 1997.

Shri C.K. Mohan Sastry, General Manager, BHEL, Bhopal, March 13, 1997.

Dr. S.K. Joshi, Ex-DG (CSIR), March 20, 1997.

APPENDIX-4

RESEARCH PAPERS AUTHORED BY RRL SCIENTISTS

1. **Sulbha Amlathe, C. Padmakar, B.Tirupati, M.V.R.L. Murthy, A.K. Mishra, and R.N. Yadava,** "Groundwater quality evaluation of shallow aquifer-Tawa canal command area, J.Bhujal News, 10, 1, 19-22, 1995.

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3. **S.S.Amritphale and N. Chandra,** "Low temperature sintering pyrophyllite compositions for wall tiles", J.Canadian Ceramic Society, 64(4), 241-44, 1995.

4. **Gomathi, N. Chandra, L.R. Sharma and G. Prabhakara Rao,**"Glassy carbon-surface characterisation by electrochemical and spectral methods", J.Bull. Electrochemistry, 11 (5), 248-52, 1995.

5. **Vincent, G. Subramanian, N. Chandra, S. Birala Sekaran, K.I.Vasu, Y. Mahadeva Iyer and G. Prabhakara Rao,** "An inexpensive electrochemical monitor for mercury", J.Bull. Electrochemistry, 11 (6), 305-8, 1995.

6. **S.R. Karade and Mohini Saxena,** "Environmental aspects in Building designing and site selection", J.Indian Archi. & Build, 75-78, 1996.

7. **A.K. Jha, S. Das, O.P. Modi, B.K. Prasad, R. Dasgupta and A.H. Yegneswaran,** "Development of materials for shovel teeth for mining industries", J.Mine Tech., 17, 2&3, 78-82, 1996.

8. **Nikkam Suresh, M. Vanangamudi and T.C. Rao,** "A performance model for water-only gravity separators treating coal", J.Fuel, 75, 7, 851, 1996.

9. **D.P. Patil, J.P. Barnwal and T.C. Rao,** "Column flotation of siliceous rock phosphate", J.Minerals and Metallurgical Processing, 13, 4, 147, 1996.

10. **B. Govindarajan and T.C.Rao,** "Development of a selection criterion for process parameters in batch coal flotation", J.Minerals and Metallurgical Processing, 13, 4, 151, 1996.

11. **B.K. Prasad, A.K. Patwardhan and A.H. Yegneswaran,** "Factors controlling the dry sliding wear behavior of a leaded-tin bronze", J.Materials Science and Technology, 12, 5, 427-435, 1996.

12. **B.K. Prasad,** "Influence of heat treatment parameters on the physical, mechanical and tribological properties of a zinc- based alloy", Journal of Z. Fur Metallkunde, 87, 3,226- 232, 1996.

13. **B.K. Prasad, A.K. Patwardhan and A.H. Yegneswaran,** "Influence of heat t parameters on the microstructure and properties of some zinc-based alloy, J.Materials 31, 23, 6317-6324, 1996.

14. **B.K. Prasad, A.K. Patwardhan and A.H. Yegneswaran,** "Dry sliding wear chara of some zinc-aluminum alloys - A comparative study with a conventional bearing slow speed", Wear, 199, 1, 142-151, 1996.

15. **B.K. Prasad, A.K. Patwardhan and A.H. Yegneswaran,** "Characterization of response of a modified zinc-based alloy vis-a-vis a conventional zinc-based alloy and bronze at a high sliding speed, J.Metallurgical and Materials Transactions, 27A, 3523, 1996.

16. **I.V Suresh, A. Wanganeo, MVRL Murthy, S.K. Sanghi and R.N. Yadava,** "I storm water run-off on efficiency of the effluent treatment plant - A case study", J Sci. Health, A31(4), 811-824, 1996.

17. **I.V. Suresh, Wanganeo A., Padmakar C. and Sujatha R.G.,** "Fluoride concent Bhopal water resources", J.Ecol. Env. & Cons. 2(11-15), 1996.

18. **B.K. Prasad, K. Venkat, O.P. Modi and A.H. Yegneswaran,** "Influence of the morphology of silicon particles on the physical, mechanical and tribological prop some Al-Si alloys", J.Materials Science Letters, 15, 10, 1773-76, 1996.

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22. **N Chand, S.A.R. Hashmi and S.R. Vashishtha,** "Influence of redmud particles inco on viscoelasticity of PS/LDPE blends", Indian J.Engineering & Materials Scienc 257, 1996.

23. **I.B. Singh and G. Venkatachari,** "Anodic behaviour of Inconel 600, 601 in sulph solutions", J.Bull Electrochemistry, 12, 83-85, 1996.

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25. **J. Prabhakar, R.S. Ahirwar and M. Saxena,** "Utilisation of industrial waste redmud in experimental housing at RRL, Bhopal", 411-416, Ibid.

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27. **R.S. Ahirwar,** "Manufacture of Redmud cement using industrial waste redmud", Udyamita Vikas, 45-47, 1996.

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3. **R.S. Ahirwar, A.C. Khazanchi and J. Prabhakar,** "Evaluation of redmud cem binder as a masonary cement interactive meet on processing of Indian Bauxite and Problem and Prospacts (Baxual-96), Bhubaneswar, Addied Publishers, 403-410, 1

4. **Mohini Saxena,** "Flyash utilization in building applications", Proc. Nat. workshop on related aspects of thermal power plants, RRL, Bhopal, organised jointly by IIM, MPCST, Bhopal, pp. 1-19, 1996.

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7. **N. Chandra and S.S. Amritphale,** "Development of a Zinc/ Bromine battery using separator", Symposium on Electrochemistry in Metallurgy and Materials Science, Banglore, August 21-24, 1996.

8. **S.P. Narayan, K. Basu, Y.V.R.K. Prasad and B.N. Das,** "A study on the forma melt-spun Nd-Fe-B alloy magnet and their applications", XIV REM Workshop held September 1-5, 1996.

9. **S.P. Narayan, K. Basu, J. Prasad and D.K. Hsu,** "Ultrasonic characterization of related parameters of Nd-Fe-B magnets", Ibid.

10. **Mohini Saxena,** "An overview on long term effect of flyash use and its impact on soi and crop yield", NTPC, Rihand Nagar (U.P.), NTPC, September 5, 1996.

11. **O.P. Modi, B.K. Prasad, A.K. Jha, S. Das, Rupa Dasgupta and A.H. Yegneswar** Influence of secondary processing on the microstructure, mechanical properties an wear behaviour of a zinc-aluminum (ZA12) alloy", poster session of the Golden J the Indian Institute of Metals and 34th National Metallurgists Day at New Delhi, N 14-17, 1996.

12. **B.K.Prasad, S. Das, A.K. Jha, O.P. Modi, Rupa Dasgupta and A.H.Yegneswaran,** "Some observations pertaining to the abrasive wear response of a zinc-based alloy SiC particle composite", Ibid.

13. **S.Das, A.K. Jha, B.K. Prasad, O.P. Modi, Rupa Dasgupta and A.H. Yegneswaran,** "Aluminum-silicon alloy-zircon particle composites: Microstructure and two-body abrasive wear behaviour", Ibid.

14. **Rupa Dasgupta, A.K. Jha, B.K. Prasad, S. Das, O.P. Modi and A.H. Yegneswaran,** "Slurry erosive wear characteristics of surface coated steels for agricultural implements", Ibid.

15. **A.K.Jha, Rupa Dasgupta, B.K. Prasad, S. Das, O.P. Modi and A.H. Yegneswaran,** "High-stress abrasive wear behaviour of some hardfacing materials", Ibid.

16. **R.S. Solanki, J.P. Pandey, B.K. Saxena and M.C. Pant,** "Structural failure of an electrostatic precipitator - A case study", Ibid.

17. **L.C Mohan,** "Glass ceramic composites from fire clay fired cupola slag", 2nd International Conference on Advances in Composites at IISc., Bangalore, December 18-20, 1996.

18. **O.P. Modi, B.K. Prasad, A.K. Jha, S. Das, R. Dasgupta and A.H. Yegneswaran,** "Material removal mechanisms during erosion - corrosion of cast aluminum (Al-Cu) alloy - SiC composites", Ibid.

19. **Aparna Chauhan,** "Bio-accumulation of flyash components by practicing Vermitechnology", 2nd review meeting on Long term effect of flyash use on soil fertility and crop yield, organised by RRL at Bhopal, December 10, 1996.

20. **Sangeeta Mandal,** "Impact of using flyash with commercial fertilizer in Agriculture", Ibid.

21. **Sangeeta Tiwari,** "Flyash as extender for paints", Ibid.

22. **Sorna Gowri,** "Protection of Bamboo surfaces by CNSL based coatings", Ibid.

23. **I.B. Singh,** "V_2O_5 accelerated hot corrosion in sulphate melt - A basic studies relevant to oil ash corrosion of power plants', Indian Chemical Engineering Congress, at Ankleswar, December 18-20, 1996.

24. **Sangeeta Tiwari and Mohini Saxena,** "Flyash as extender for corrosion and Abrasion resistant paints", National Seminar on Tribomaterials : Synthesis, characterization and application, at RRL, Bhopal, organised by MRSI, Bhopal Chapter, December 23-24, 1996.

25. **S.A.R. Hashmi and N. Chand,** "Effect of addition of Polycarbonate on high stress wear properties of polypropylene/polycarbonate/redmud composites", Ibid.

26. **N. Chand and S.A.R. Hashmi,** "Analysis of abrasive wear behaviour of redmud fi polypropylene/low density polyethylene", Ibid.

27. **N. Chand and A. Naik,** "Determination of natural frequencies and mode shapes of g fibre reinforced polymer composite", Ibid.

28. **B.K. Prasad, A.K. Jha, S. Das, O.P. Modi, Rupa Dasgupta and A.H. Yegneswar** "Improvement in component life through tribological studies", Ibid.

29. **Rupa Dasgupta, A.K. Jha, B.K. Prasad, O.P. Modi, S. Das and A.H. Yegneswaran,** "Surf engineering for improved tribological performance of mining and agricultural implemen Ibid.

30. **S. Das, B.K. Prasad, A.K. Jha, O.P. Modi, Rupa Dasgupta and A.H. Yegneswar** "Development of Al-alloy particle Composites and SLIZ alloys for tribolog applications",Ibid.

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32. **K. Venkateswarlu, B.K. Prasad, S. Das, O.P. Modi and A.H. Yegneswaran,** "Effect Silicon morphology on the properties of aluminium-silicon alloys", Ibid.

33. **S.R. Karade,** "Waste to Wealth : Red Mud Utilisation for Wood substitute and mentit binder", Material Science Section of the 84th Session of the Indian Science Congres Delhi University, January, 1997.

34. **P. Asokan, Mohini Saxena, Aparna Chauhan and Sangeeta Mandal,** "Utilization of c ash to improve the soil fertility and in building application", Symposium of Utilizatio Coal Ash, organised by Karnataka Power Corporation Ltd. and ACC, at Bangalore, Janu 10, 1997.

35. **B.C. Chakradhar,** "Recycling reclamation and waste reduction techniques for managem of hazardous waste, IEFMA-97", National workshop on waste minimisation and managem strategies, Udaipur, January 17-18, 1997.

36. **B.C. Chakradhar and A. Mahrotra,** "Waste minimization and management practi IEFMA-97", Ibid.

37. **R.S. Solanki, J.P. Pandey and B.K. Saxena,** "Practical approach to remnant life assessm and life extension",organised by World Council of Power Utilities (WCPU) at New De February 12-14, 1997.

38. **Aparna Chauhan,** "Organic waste vermicompost admixed with flyash - An enriched medi for Agro ecosystem", M.P. Young Scientist Congress, at Bilaspur, February 28-2 March, 1

39. **Sangeeta Mandal,** "Potential impact of flyash for sustaining agricultural crops", Ibid.

40. **Sangeeta Tiwari,** "New raw materials for paints from industrial wastes", Ibid.

41. **Sorna Gowri,** "Protection of Bamboo surface by CNSL based coatings", Ibid.

42. **P. Asokan and Mohini Saxena,** "Utilisation of Fly ash in suitable Agriculture -Workshop on Flyash Utilisation organised by NALCO, Orissa, held at Angul NALCO, Orissa, March 4, 1997

43. **Navin Chand and S.A.R. Hashmi,** "Rheological studies of blends", All India Seminar on Recent Advances in Synthesis and Manufacturing Process of Plastics, Rubber and Fibres, at Indore, March 13-14, 1997.

44. **Mohini Saxena, P. Asokan, Alka Meshram and Sangeeta M.,** "Improvement of fertility of wasteland by the application of Coal Ash at NTPC Rihand Nagar - A Case study", DST, New Delhi, held on March 30-31, 1997.

45. **P. Asokan, Mohini Saxena, S. Srimanth, and Aparna Chauhan,** "Impact of coal ash on soil fertility - A case study on Physico Chemical changes", Ibid.

46. **Aparna Chauhan, Mohini Saxena and Asokan P.,** "Organic Manure prepared from Eisenia foetida admixed with flyash - An enriched medium for Agro ecosystem", Ibid.

47. **Aparna Chauhan,** " Copper Accumulation by the microbes isolated from the flyash", Ibid.

48. **Sangeeta Mandal and Mohini Saxena,** "Impact of flyash for sustaining agricultural crops in black cotton soil - A feasible waste management", Ibid.

APPENDIX-6

LECTURES

Invited Lectures by Experts

Dr. A.S. Rao, "Issues in Technology Management", June 27, 1996.

Shri H.R. Hirwani, "Technology in the Context of R&D Management", June 28, 1996.

Dr. Akhtar Uddin Ahmed, "R&D activities of Housing & Building Research Institute, Dhaka, Bangladesh", August 26, 1996.

Shri M.N. Buch, " India of our Dreams", National Council of Human Settlement and Environment (NCHSE), Bhopal, February 28, 1997.

Prof. M.A.L. Thattachar, " Recognition of Learning Patterns and Control, IndianInstitute of Science, Bangalore, March 13, 1997.

Lectures delivered by RRL Staff

Dr. Mohini Saxena, "Flyash utilization for wasteland development", at MPEB, Jabalpur, organised by MPEB, April 29, 1996.

Dr. Mohini Saxena,"Long term effect on flyash on soil fertility and crop yield", at DST, New Delhi, organised by TIFAC, May 2, 1996.

Dr. Mohini Saxena,"Utilization of flyash in Building Applications", in the National Workshop on Materials Related Aspects of Thermal Power plants, held at RRL, Bhopal, June 12-13, 1996.

Dr. Rupa Dasgupta,"Improved performance of aluminum alloys through rapid solidification processing", Technical University, Berlin, Germany, June 14, 1996.

Dr. Rupa Dasgupta,"R&D activities at RRL Bhopal with special reference to aluminum and tribology", F.M.T., Wuppertal, Germany, June 20, 1996.

Dr. Navin Chandra, "Materials characterisation and calibration activities at RRL, Bhopal", Meeting on Renovation and Modernisation of testing and calibration facilities in CSIR Laboratories, August, 1996.

Dr. Mohini Saxena, "Flyash use for wasteland", organised by IFFCO at Allahabad, September 10, 1996.

Dr. Mohini Saxena, "Utilisation of flyash on industrial wastes", Workshop on sustainable productive systems for construction materials, organised by Development Alternatives, India, International Centre, New Delhi, September 30, 1996.

Dr. B. Chakradhar, "Environmental impact of power generation", National Convention'96 on Energy Crisis and Environmental Protection : A challenge to Industry organised by National Institute-Industry Forum for Energy at Indore, October 14, 1996.

Shri S.R. Karade, "Appropriate rural technologies developed at RRL" in a Training Programme organised at Kesla, Hoshangabad by National Council of Human Settlement & Environment (NCHSE) and CBRI Extension Centre, Bhopal, October 24, 1996.

Dr. B. Chakradhar, "On-site emergency plans and evaluation technique", Disaster Management Institute, Bhopal, October 29, 1996.

Shri R.S. Ahirwar, "Appropriate rural technologies developed at RRL", in a training programme organised at Paras Nirmitti Kendra, Nainagiri and CBRI, Extention Centre, November 3,1996.

Shri R.S. Solanki, "Welding of ETP Copper", Crompton Greaves Ltd. Bombay, November 28th, 1996.

Prof. T.C. Rao,"SWOT analysis of mineral engineering", Indian Institute of Science, Banglore, November 29, 1996.

Shri P. Asokan," Utilization of flyash for the imporvement of agricultural production", at NALCO, Angul, organised by NALCO Bhubaneswar, December 6, 1996.

Shri P. Asokan,"Utilisation of flyash in Building Industry and for Wasteland Development", Symposium organised by Karnataka Power Corporation Limited & Associated Cement Companies Ltd., Bangalore, January 10, 1997.

Dr. Navin Chandra, "Laboratory evaluation of corrosion susceptibility of Metals", The Institution of Engineers(India), M.P. State Centre, Bhopal, January 11, 1997.

Dr. S. Das, "X-ray diffraction techniques in the characterisation of engineering materials", Ibid, January 12, 1997.

Shri R.S. Solanki, "Experimental approach for evaluation of weldability", Ibid, January 13, 1997.

Dr. O.P. Modi, "Metallography", Ibid.

Shri S.R. Karade, "Clay fly ash bricks and wood substitute Materials", Training programme for PWD Executives & Astt. Engineers, at Academy of Administration, Bhopal, January 31st, 1997.

Shri J. Prabhakar, "Construction of Experimental Prototype Houses", Ibid.

Dr. R.N. Yadava, an interview on"Watershed Development"at Doordarshan Kendra, Science Section, Bhopal, February 4, 1997.

Dr. T.C. Rao, "Story of Coal and Fly Ash", at Regional Science Centre, Bhopal, February 25, 1997.

Dr. T.C. Rao, "Coal and Ash in Power Plants", at Annual General Meeting of MRSI at BARC, Bombay, February 1997.

Dr. R.N. Yadava, an interview on "Water Resources" at Doordarshan Kendra, Science Section, Bhopal, February 26, 1997.

Dr. R.N. Yadava,"Water Resources Management in M.P.", Workshop on "Small-Hydro" organised by MACT, Bhopal, March 10, 1997.

Dr. Navin Chand, "PP/Nylon/RM Blend Composites", All India Seminar on "Recent Advances in Synthesis and Manufacturing of Plastics, Rubber and Fibres", at Indore, March 13-14, 1997.

Dr. T.C.Rao, "Role of Citizen in Environment Protection", A Lecture programme on Environment Protection, at British Library, Bhopal, March 17, 1997.

Internal Seminars

V.S. Muneshwar, "Role of ISO-2000 in quality management", April 12, 1996.

Dr. R.N. Yadava, "Opportunity for an international co-operation", April 19, 1996.

Dr. C.B. Raju, "Structure of clay minerals", April 26, 1996.

Dr. M.V.R.L. Murthy, "Artificial recharge mechanism design guidelines", May10,1996.

S.P. Narayan, "Development of processing map for Nd-Fe-B magnets", May 31, 1996.

Dr. D.P. Patil, "Separation of lead graphite using water only cyclone", June 7, 1996.

Murari Prasad, "Beneficiation of calcareous phosphates by reverse flotation", July 5,

Dr. Navin Chand, "Carbon fibre - PPS composite tape", July 12, 1996.

Dr. I.B. Singh, "Cooling water treatment", July 26, 1996.

Amit Asthana, "Separation of carbonyl compound by capillary electrophoresis with UV detection" July 26, 1996.

Dr. B.K. Prasad, "Application potential of zinc aluminum alloys", August 2, 1996.

Dr.(Ms) Aparna Chauhan, "Contribution of earthworm in the making of compost and ", their role in the management of wasteland development August 2, 1996.

K. Venkateswarlu, "Non-destructive inspection technique", August 8, 1996.

Ms. Deepali Deshmukh, "Removal of metal ions from effluent water", August 9, 1996.

Ms. B. Bharathi, "Application of remote sensing for natural resources inventory in Dudhi catchment", August 9, 1996.

C. Padmakar, "Geographic information systems - An introduction", August 23, 1996.

P.D. Ekbote, "Precept & practice of patents and publications", August 30, 1996.

Dr. (Mrs.) Arati Roy, "Modelling for prediction of a crack in bonded material", September 13, 1996.

Debashish Bose, "Determination of beuzodiazepines using high performance liquid chromatography with UV detection", September 13, 1996.

Dr. S.K. Sanghi, "Capillary electrophoresis of environmental pollutants", September.

Ms. Divya Dawar, "Self purification of a natural stream", September 20, 1996.

Dr. (Ms.) Mohini Saxena, "Utility of herbal extract in medicines", September 27, 1996.

Edward Peters, "Remote sensing satellites in our space", September 27, 1996.

Harsha Vardha, "Rejuvenation of clogged hand pumps", October 18, 1996.

Manish Mudgal, "Stack monitoring for a industry - Demonstration", October 18, 1996.

P.K. Chauhan, "Maintenance of office and Residential buildings", January 10, 1997.

J.P. Pandey, "Operation of thermal power plant", January 17, 1997.

Ms. Sangeeta Tiwari, "Flyash as extender for paints ", January 17, 1997.

S. R. Karade, "Non destructive evaluation of concrete structures", January 31, 1997.

Jayant Konar, "Chemical analysis with special reference to Atomic Absorption spectrophotmetry", February 14, 1997.

Poonam Saxena, "An electronic water level indicator", February 21, 1997.

APPENDIX-7

SEMINARS/WORKSHOPS/CONFERENCES ATTENDED BY RRL STAFF

1. **S.P. Narayan,** 13th National Seminar of Magnetic Society of India (MSI), held at Pune on May 14-15, 1996.

2. **Dr. Mohini Saxena,** National Workshop on Enhancing Employment Opportunities for Rural Women, CIAE, Bhopal, May 28-29, 1996.

3. **Prof. T.C. Rao,** Workshop on "The Indian Coal Perspective to 2010", World Coal Institute at New Delhi, June 7, 1996.

4. **R.S. Solanki,** National Workshop on Materials Related Aspects on Thermal Power Plant, RRL Bhopal, June 12-13, 1996.

5. **Dr. R.N. Yadava, P.D. Ekbote, Dr. MVRL Murthy and Dr. Arati Roy,** Eleventh Annual Conference on "Ramanujan Mathematical Society", organised by Department of Mathematics and Computer Application, MACT, Bhopal, June 26-28, 1996.

6. **P.D. Ekbote,** Training Programme held at Intellectual Property Management Division (IPMD), CSIR, New Delhi, July 15-19, 1996.

7. **Dr. R.N. Yadava, Dr. MVRL Murthy, B. Tirupati and Dr. B. Chakradhar,** Workshop on "Watershed Development for Dhar, Jhabua and Ratlam", July 20-21, 1996.

8. **Dr. R.N. Yadava and Dr. MVRL Murthy,** Workshop on "Integrated Farmers Information System", organised by M.P. State Agr. Mkt. Board, Bhopal, July 26, 1996.

9. **Devilal Rathore,** Workshop on "Creation of Public opinion in Watershed Management", organised by National Centre for Human Settlements(NCHSE) & Environment and M.P. Watershed Management Development Association, Bhopal, August 19-24, 1996.

10. **S.R. Karade and Sona Gowri,** Course on "Extrusion Technologies in Plastic Moulding" at CIPET, Bhopal, September 18-20, 1996.

11. **Dr. Mohini Saxena and Dr. Arati Roy,** attended Meeting on "Science and Technology inputs for women", MAPCOST, Bhopal, Sept. 20, 1996.

12. **S.R. Karade, J. Prabhakar and R.S. Ahirwar,** "Finite Element Analysis-Principal and Practices", NAL, Bangalore, December 18-20, 1996.

13. **P.K. Rangari and S.K. Suryavanshi,** Training programme in "Leather Goods Manufacture and Pedagogical", at Central Leather Research Institute, Madras, September 6-February 28, 1997.

14. **P.D.Ekbote,** One-day Awareness Programme on Customer Satisfaction Research for R&D Systems, organised by CSIR, New Delhi, September 22, 1996.

15. **R.S. Ahirwar and J. Prabhakar,** "Vision-2001", organised by AISECT, Bhopal, October, 1996.

16. **Dr. Aparna Chauhan, Sorna Gowri, Sangeeta Tiwari, and Sangeeta Mandal,** attended International Seminar and Short course on "High Performance Chromatography and Capillary electrophoresis", at RRL, Bhopal, Jointly organised by RRL,Bhopal, University of Amsterdam, Netherlands and Rani Durgavati University, Jabalpur, November 11-21, 1996.

17. **Dr. A.H. Yegneswaran, S.P. Narayan, Dr. A.K. Jha, D.P. Mondal, Dr. S. Das, Dr. O.P. Modi, Dr. B.K. Prasad, R.S. Solanki, Dr. Rupa Dasgupta, K. Venkateswarlu and J.P. Pandey,** "Golden Jubilee of the Indian Institute of Metals and 34th National Metallurgists Day" at New Delhi, November 14-17, 1996.

18. **R.S. Solanki,** International Seminar on "Asia Energy Vision 2020-Sustainable Energy Supply in Asia, New Delhi, November 15-17, 1996.

19. **B. Kujur,** Training Programme on "Analytical Instrumental IR-96" conducted by Labindia at Pune, December 15-19, 1996.

20. **Dr. R.N. Yadava and B. Tirupati,** 16th International Congress on"Carto Vision 2001 and Earth Resource Management" organised by Survey of India at IIT, New Delhi, December 16-19, 1996.

21. **Dr. Navin Chand, J. Prabakar and S.R. Karade,** Short Course on "Finite Element Analysis : Principles and Practices" organised by NAL, Banglore, December 18-20, 1996.

22. **L.C. Mohan and Dr. O.P. Modi,** 2nd International Conference on "Advances in Composites" at IISc., Banglore, December 18- 20, 1996.

23. **Dr. I.B. Singh,** "Indian Chemical Engineering Congress" at Ankleswar, December 18-20, 1996.

24. **Dr. Rupa Dasgupta, Dr. A.K. Jha, Dr. B.K. Prasad, Dr. O.P. Modi, Dr. S. Das, Dr. A.H. Yegneswaran, TSV Chakradhar Rao, and M.S. Yadav,** attended the National Seminar on "Tribomaterials: Synthesis, Characterisation and Applications", Bhopal, December 23-24, 1996.

25. **Dr. Mohini Saxena and Arati Roy,** attended Meeting on "Science and Technology inputs for women",MAPCOST, Bhopal, January 1, 1997.

26. **Rishi Kumar,** Meet on "Information Today and Tomorrow", at NCL, Pune, January 7-10, 1997.

27. **B. Kujur, K. Venkateswarlu, Jayant Konar, S.R. Karade and K.K. Rao,** National Workshop on "Characterisation of Engineering Materials" at the Institution of Engineers (India), M.P. State Centre, Bhopal, January 11-13, 1997.

28. **Dr. B. Chakradhar and Dr. I.B. Singh,** National on "Waste minimization and management stratigies", Udipur, January 17-18, 1997.

29. **P.D. Ekbote and Dr. Rupa Dasgupta,** Workshop on "Patent Awareness", organised by Madhya Pradesh Council of Science & Technology (MPCST) jointly with TIFAC, at the Academy of Administration, Bhopal, January 20, 1997.

30. **Manik Chandra and P.C. Meshram,** Conference on "Impact of Electronics on Automation" Department of Electronics and Computer Engineering at University of Roorkee, January 20-21, 1997.

31. **R.K. Morchhale and R.S. Ahirwar,** Training Programme on "Analysis and Design of Civil Engineering Structures for Vibration", at SERC, Chennai, January 21-24, 1997.

32. **P.D. Ekbote and Dr. S. Das,** TQM and HRD Mission of CII (MP region) at Pune, January 23-25, 1997.

33. **L.C. Mohan and J.P. Pandey,** 45th Indian Foundry Congress at Mumbai, January 25-27, 1997.

34. **Raghuvanshi Ram,** Exhibition on "Watershed Development",organised by Administration, Raisen during the celebration of Republic Day at Parade Ground, Raisen, January 26, 1997.

35. **Rajeev Mishra and Mohd. Akram Khan,** Seminar on "Leather Research Industry Get-Together (LERIG-97)" at CLRI, Madras, January 27-30, 1997.

36. **Dr. Rupa Dasgupta,** Workshop on "Preparation of Foreign Deputation Reports", organised by International S&T Affairs Directorate & Centre for Cellular and Molecular Biology, at Hyderabad, January 29-31, 1997.

37. **J. Prabhakar and S.R. Karade,** Training Programme for PWD Executive and Assistant Engineers, at Academy of Administration, Bhopal, January 31, 1997.

38. **V.S. Muneshwar,** Training programme on "Laboratory Quality System and Management" at Jaipur, February 4-6, 1997.

39. **Dr. A.K. Jha,** VIII Annual General Body Meeting and Seminar on"Energy Related Materials" organised by MRSI, Bombay Chapter at BARC, Bombay, February 9-14, 1997.

40. **R.S. Solanki,** International Conference on "Green Power", February 12-14, 1997.

41. **M.K. Ban and P.C. Meshram,** Training Programme in "Analytical Instrumental AAS-97", at Labindia Instruments Pvt. Ltd., Pune, February 17-19, 1997.

42. **Dr. Kunal Basu and S.P. Narayan,** Workshop on "ISO-9001 Awareness Programme for CSIR Laboratories", at CFRI, Dhanbad, February 20-22, 1997.

43. **Dr. Navin Chand,** Conference on "Plastics in Sustainable and Plastics in Agriculture", organised by Plast India, New Delhi, March 3, 1997.

44. **J. Prabakar,** Workshop on "Composite Materials and Waste Minimization", Bergamo, Italy, March 3-7, 1997.

45. **Dr. R.N. Yadava, Dr. M.V.R.L. Murthy and B. Tirupati,** Workshop on "Small-Hydro" organised by MACT, Bhopal, March 10, 1997.

46. **K. Udaya Bhaskar,** Seminar on "Coal-Trans", New Delhi, March 10-11, 1997.

47. **Dr. B. Chakradhar,** Workshop on "Nutrient Analysis in Water and Waste Water", Brisbane, Australia, March 10-16, 1997.

48. **Dr. Navin Chand and S.A.R. Hashmi,** All India Seminar on "Recent Advances in Synthesis and Manufacturing Process of Plastics,Rubber and Fibres", at Indore, March 13-14, 1997.

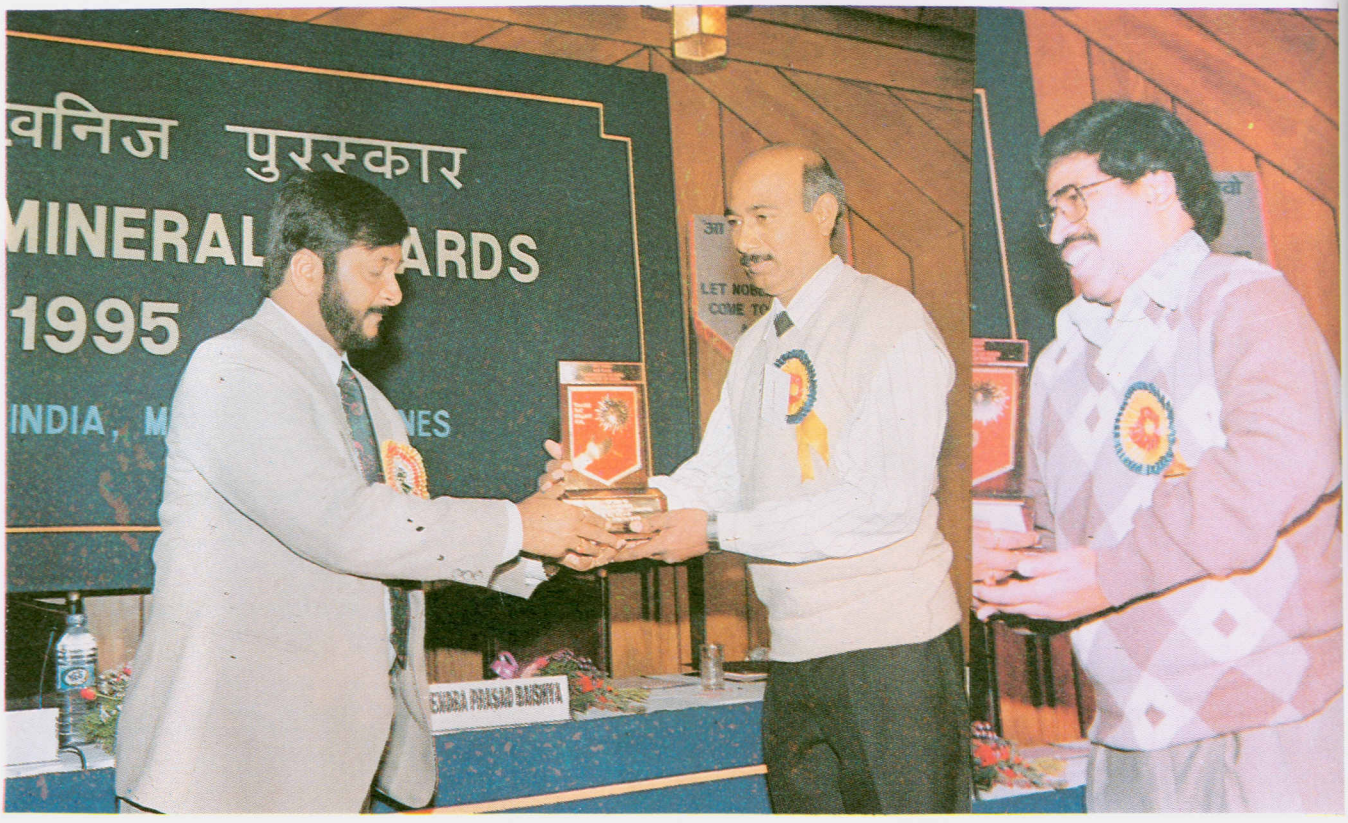
49. **H.N. Rao, B. Kujur and Manik Chandra,** Workshop on safety in the chemical laboratories and pilot plant, at Mumbai, March 17-19, 1997.

50. **Dr. Satyendra Narayan,** National Seminar on, Contaminant Migration in Deep Groundwater", Bhabha Atomic Research Centre at Mumbai, March 19-21, 1997.

APPENDIX-8

AWARDS

Prof. T.C. Rao	-	Awarded "Dr. Rajendra Prasad Memorial Medal" for the paper entitled "A case study on grindability of iron ore" for the year 1995-96, by The Institution of Engineers, Bangalore, December 21, 1996.
Shri S.P. Narayan	-	Awarded " Tamhanker Memorial Award ", for the paper entitled "Plastic Deformation of Nano-crystalline NdFeB Magnets & Devlopment of Magnetic Anisotropy", Magnetics Society of India (MSI), Pune, 14-15th, May 1996.
Dr. J.P. Barnwal Dr. B. Govindarajan	-	Awarded "National Mineral Award" in the area of Mineral Beneficiation, for outstanding contribution in coal preparation, by Ministry of Steel & Mines, Govt. of India.
J.P. Pandey	-	Awarded "Prof. P. Banerjee Memorial Best M. Tech. Thesis Award 1995-96", by the Institute of Indian Foundrymen, for his M. Tech. Thesis.
Dr. Aparna Chauhan Sangeeta Mandal Sangeeta Tiwari	-	Awarded "M.P. Young Scientist Awards", by Madhya Pradesh Council of Science and Technology, 12th M.P. Young Scientist Congress, in their respective fields.: Agricultural Science Engineering Science & Technology Environmental Science & Forestry



Dr. J.P. Barnwal and Dr. B. Govindarajan, Scientists receiving the National Mineral Award from Union Minister of Steel & Mines

VISITS ABROAD

- Dr. Rupa Dasgupta, Scientist C, visited Technical University Berlin, under CSIR-DAAD Scientist Ex-change programme, May-June, 1996.

- Mr. K. Venkateswarlu, Technical Officer, visited Kyusher International Center, Kirakyusher, Japan for training in NDT, July 7, 1996.

- Dr. A.H. Yegneswaran, Scientist EII, visited Mechanical Engineering Laboratory (MEL), Agency of Industrial Science & Technology, Tsukuba, Ibaraki, Japan for ITIT Research Project"Precision forging technology to manufacture net-shape parts", October-November 1996.

- Dr. J.P. Barnwal, Scientist C, visited Department of Metallurgical Engineering, Michighan Technological University, Michighan under Indo-US collaborative research project sponsored by NSF, USA.

- Dr. B. Govindarajan, Scientist B, has gone to visit Southern Illinois University, Carbondale for carrying out Post Doctoral Fellowship January-December, 1997.

- Mr. J. Prabhakar, Scientist B, visited Bergamo, Italy to participate in the Workshop on "Composite Materials and Waste Minimization", March 3-7, 1997.

- Dr. B. Chakradhar, Scientist EI visited Brisbane, Australia to participate in the Workshop on "Nutrient Analysis in Water and Waste Water", March 10-16, 1997.

MEMBERSHIPS OF COMMITTEES etc.

Prof. T.C. Rao	- Member, Governing Body of M.P. STEP MACT, Bhopal.
	- Member, Board of Courses and studies for the Department of Fuel and Mineral Engineering, Dhanbad.
	- Chairman, Local Advisory Committee, Regional Science Centre, Bhopal.
	- Chairman, The Indian Institute of Metals, Bhopal Chapter for the year 1996-97.
	- Member, Scientific Education Advisory Committee of Madhya Pradesh Govt.

HIGHER EDUCATION RELATED

J.P. Pandey	-	M.Tech from MACT.
T.S.V.C. Rao	-	AMIIM in Metallurgy from III
N.S. Jadav	-	Diploma in Library & Inform Science from Barkatu Vishwavidyalaya, Bhopal.

RETIREMENT

Shri S.K. Bose Scientist F, Retired on Superannuation, on July 31, 1996.

APPOINTMENT/TRANSFER

Dr.(Mrs.) Manisha Dubey, Jr.Translator(H)	-	transferred to CRRI, New Delhi.
Dr. Satyendra Narayan, Scientist B	-	on transfer from CMRI, Dhanbad.
S. Chandrahas, Section Officer (F&A)	-	transferred to NPL, New Delhi.
Vinod Kumar Anand, Section Officer (F&A)	-	on transfer from NISTADS, New D

RESIGNATION

Sandeep Kumar Doraiburu, Section Officer